77715900

CONTROL DATA CORPORATION

# CONTROL DATA®
## FLEXIBLE DISK DRIVE
## MODEL 9428

GENERAL DESCRIPTION
OPERATION
INSTALLATION AND CHECKOUT
THEORY OF OPERATION
DIAGRAMS AND MAINTENANCE AIDS
MAINTENANCE
WIRE LISTS
PARTS DATA

MAGNETIC PERIPHERALS, INC.
a Control Data Company

## HARDWARE MAINTENANCE MANUAL

## REVISION RECORD

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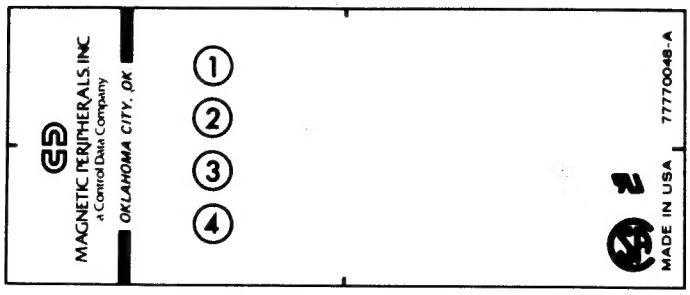
REVISION I, O, Q, S, X and Z ARE NOT USED.





Address all comments concerning this publication to the distributor or use the enclosed user comment sheet located in the back of this publication.

## FDD CONFIGURATOR SHEET




(1) EQUIPMENT TYPE NUMBER

(2) HARDWARE PRODUCT CONFIGURATOR NUMBER (HPC)

(3) SERIAL NUMBER INCLUDING SERIES CODE (BLOCK POINT). EXAMPLE: IN SERIAL NUMBER SN 01000234 THE FIRST TWO DIGITS "01" IS ALSO THE SERIES CODE (BLOCK POINT).

(4) LOT NUMBER, MANUFACTURER LOCATION AND DATA CODE

H149a

**WARNING**

" This product is an electromechanical device which could present hazards if improperly handled. The device should be maintained only by qualified personnel in accordance with instructions contained in this manual and sound safety practices. Careless disassembly or maintenance procedures may result in damage to the device or injury to personnel. Observe all CAUTIONS or WARNINGS attached to the device or contained in this manual.

These WARNINGS and or CAUTIONS are not exhaustive. The manufacturer cannot know in advance all possible maintenance procedures, or tools, which may be devised by persons who choose not to follow the instructions in this manual. Any deviation from the prescribed procedures may entail risks which have not been evaluated by the manufacturer.

Any persons who use a non-approved procedure or tool must satisfy themselves that no injury to personnel, no damage to the device, and no deterioration of device performance will result."

# PREFACE

This manual provides the information needed to install, operate and maintain the Model 9428 Flexible Disk Drive (FDD) (BR8B3A) and is intended to support customer engineers who require detailed information about the Flexible Disk Drive's operation.

The manual is composed of two publications, each having a unique publication number, contained in one volume. The Manual's Publication number (77715900) is that of the front matter, Sections 1 through 7. This number should be used when making reference to the 9428 Flexible Disk Drive Hardware Maintenance Manual. Section 8, Parts Data, is identified by a separate publication number.

## FCC NOTICE

This equipment generates and uses radio frequency energy. If not installed and used properly, that is, in strict accordance with the manufacturer's instructions, it may cause interference to radio and television reception.

It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, when installed within the host cabinet of a certified Class B computer. The referenced FCC rules are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment OFF and ON, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the equipment with respect to the receiver
- Move the equipment away from the receiver
- Plug the equipment into a different outlet so that equipment and receiver are on different branch circuits.

If necessary, you should consult the dealer or an experienced radio television technician for additional suggestions. You may find the following booklet prepared by the Federal Communications Commission helpful: How to Identify and Resolve Radio-TV Interference Problems.

This booklet is available from the US Government Printing OFfice, Washington DC 20402, Stock No. 004-0000-00345-4.

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## 1.1 INTRODUCTION

The Model 9428 Flexible Disk Drive (FDD) is a compact, random access, data storage device that interfaces with a central processor through a control unit. Input/Output data and control signals are transmitted by means of an I/O cable. The FDD may be connected in star or daisychain configuration. In star configuration, each FDD is connected to a separate controller port. Up to four drives may be connected to a single port in daisychain configuration.

## 1.2 PURPOSE AND USE OF EQUIPMENT

Data, in the form of magnetic flux reversals, is written on, or read from the tracks of a rotating diskette. The FDD uses a single, 5.25-inch (133.4 mm) flexible, removable diskette (two recording surfaces) enclosed in a sealed jacket. The unit is capable of hard sector or soft sector format operation.

## 1.3 PRODUCT DESCRIPTION

The device contains a mechanism to mount and rotate the media, a track accessing positioner, writing, reading, and interface control circuitry. Interface signals, power, physical size, and mechanical mounting levels are compatible with standard industrial requirements. Media interchange is achieved with standard formats.

### 1.3.1 PHYSICAL DESCRIPTION

The physical dimensions for the equipment are given in Figure 1-1.

### 1.3.2 ELECTRICAL DESCRIPTION

The electrical specifications for the equipment are as follows:

DC POWER

| | | |
|---|---|---|
| +12 V ±5% 1.0 A typical | 1.2 A max.* | Ripple 100 mV p-p |
| + 5 V ±5% 0.5 A typical | 0.5 A max.* | Ripple 100 mV p-p |

AC POWER

None

*NOTE: Specified current requirements are on a per drive basis. Current requirement increases by a factor equal to the number of drives per power supply. (i.e., Two drives per supply require +12 V at 2.4 A and +5 V at 1.0 A.)

| CODE | PACKAGE DIMENSION | |
|---|---|---|
| | INCHES | MILLIMETRES |
| A | 8.00 MAX | 203.2 |
| B | 5.75 $^{+.00}_{-.02}$ | 146.0 |
| C | 0.19 ±.01 | 4.82 |
| D | 1.87 ±.02 | 47.5 |
| E | 3.12 ±.02 | 79.2 |
| F | 5.88 ±.01 | 149.4 |
| G | 1.625 ±.01 | 41.3 |
| H | 0.060 ±.01 | 1.5 |
| I | 5.50 ±.02 | 140.0 |
| J | 0.394 ±.02 | 10.0 |
| K | 0.030 ±.01 | 0.762 |
| L | 0.66 ±.01 | 16.7 |
| M | 0.580 | 14.7 |
| N | 0.86 ±.02 | 21.84 |

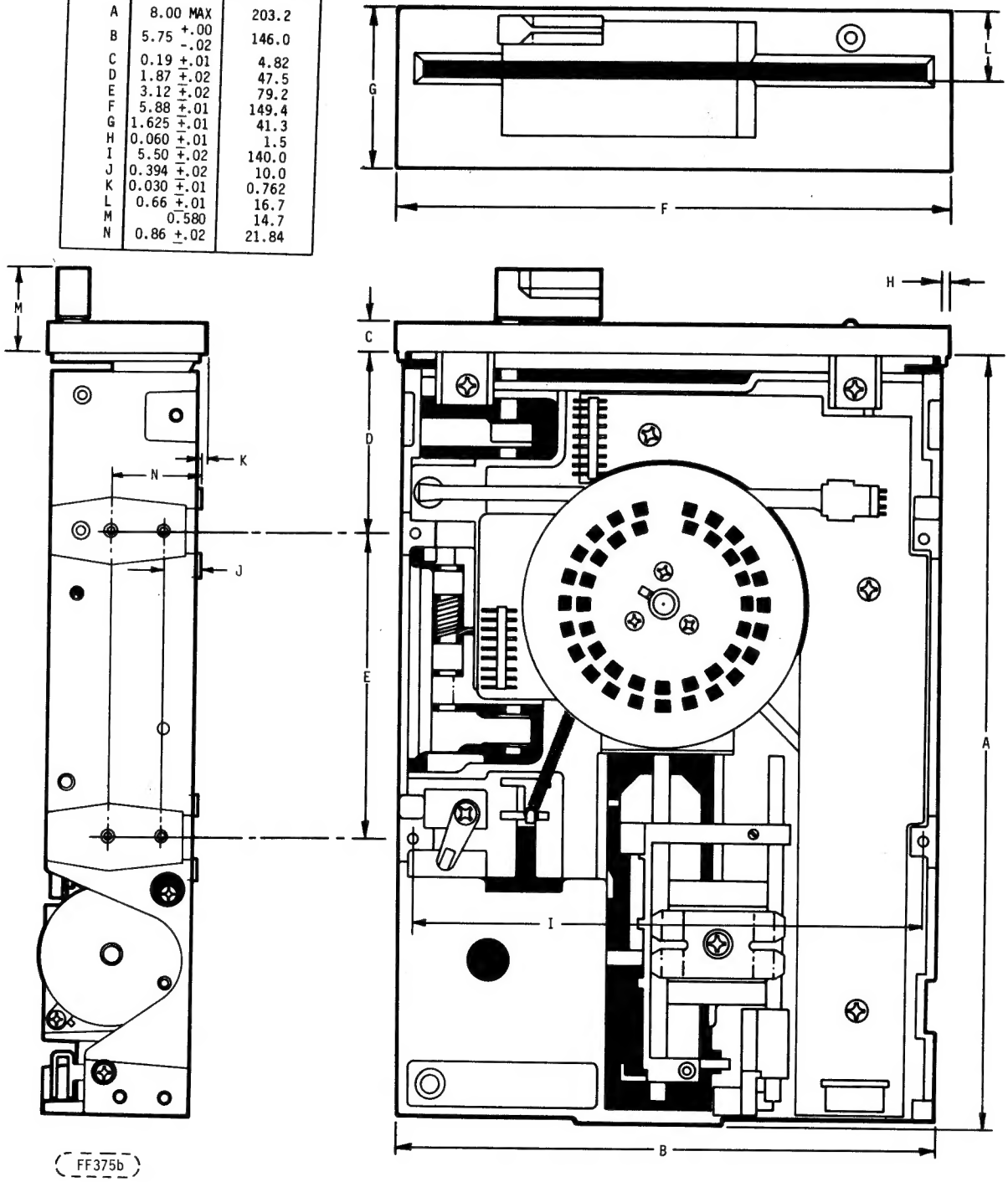


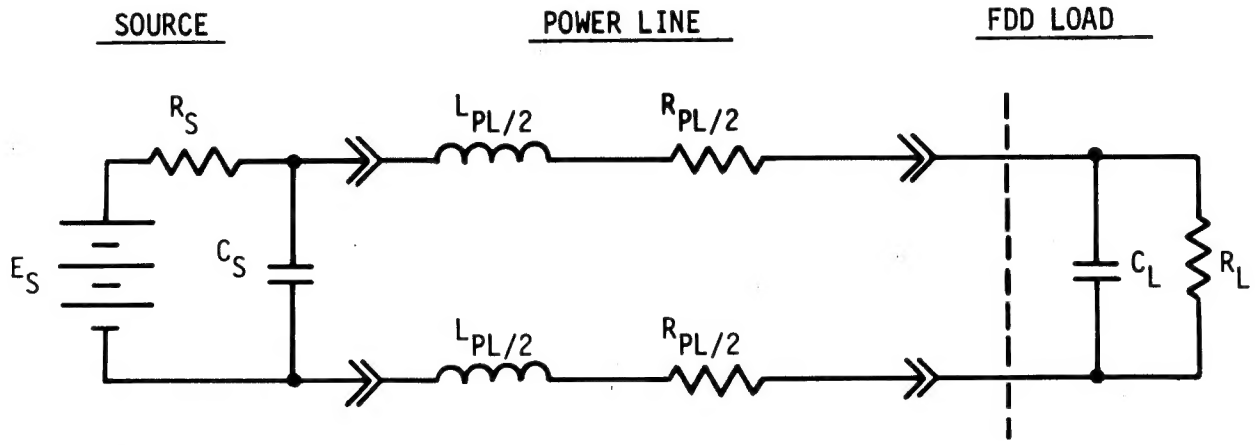

FIGURE 1-1. OVERALL AND MOUNTING DIMENSIONS OF 9428 FDD

POWER DISSIPATION

18.9 Watts (Maximum)
14.5 Watts (Nominal)

INRUSH CURRENT

Inrush current is dependent upon the power source as well as the FDD. Primary considerations are: 1. host power supply source impedance(s); 2. host to FDD power line resistance and inductance; and 3. FDD capacitance load presented by filter capacitors. Schematically, this may be represented as shown below:




INPUT IMPEDANCE

The nominal equivalent loads for the 9428 are as follows:

| | +12 V | +5 V |
|---|---|---|
| $C_L$ | 25 microfarads | 50 microfarads |
| $R_L$ | 12 ohms | 10 ohms |

## 1.3.3 ENVIRONMENTAL CONSIDERATIONS

| | Operating * | Shipping and Storage |
|---|---|---|
| Device Ambient Temperature | 40° F to 115° F (4.4°C to 46.1°C) | -40° F to 144° F (-40°C to 62.2°C) |
| Relative Humidity | 20% to 80% | 0% to 95% |
| Maximum Wet Bulb | 79° F (26.1°C) | No condensation |

*Actual operating temperature is limited by media environmental specifications and performance.

## 1.3.4 PERFORMANCE CHARACTERISTICS

The equipment specifications for the FDD are as follows:

| | Single Density | Double Density |
|---|---|---|
| Capacity | | |
| Unformatted | | |
| Per disk | 250 kbytes | 500 kbytes |
| Per surface | 125 kbytes | 250 kbytes |
| Per track | 3.1 kbytes | 6.2 kbytes |
| Formatted (16 sectors, 128/256 bytes) | | |
| Per disk | 163.84 kbytes | 327.68 kbytes |
| Per surface | 81.92 kbytes | 163.84 kbytes |
| Code | FM | MFM |
| Transfer Rate | 125 kbits/s | 250 kbits/s |
| Average latency | 100 ms | 100 ms |
| Seek Time | | |
| Track to track | 5 ms | 5 ms |
| Average | 80 ms | 80 ms |
| Settling time | 15 ms | 15 ms |
| Side Select Time | 200 µs** | 200 µs** |
| Media | Hard/Soft Sector | Hard/Soft Sector |
| Rotational Speed | 300 r/min ±1.5% | |
| Track Density | 48 TPI | |
| Flux Reversal Density (Track 39, Side 1) | 5876 FRI | |
| Number of Tracks | 40 | |
| Inner recorded radius (Side 0) | 1.437 in (36.53 mm) | |
| Outer recorded radius (Side 0) | 2.250 in (57.2 mm) | |
| Inner recorded radius (Side 1) | 1.354 in (34.16 mm) | |
| Outer recorded radius (Side 1) | 2.167 in (55.0 mm) | |

## 1.3.5 FLEXIBLE DISKETTE

CDC 445 or equivalent (Double Density)
CDC 444 or equivalent (Single Density)

**Assumes motor on and drive selected.

## 2.1 INTRODUCTION

The FDD is under direct control of the input/output commands and power sources. No special start up procedure is required. Operation is fully automatic and normally requires no operator intervention.

## 2.2 OPERATING INSTRUCTIONS

Verify that power and I/O cables are securely attached before operation.

### 2.2.1 FLEXIBLE DISKETTE LOADING

a. Apply DC power to drive.
b. Turn diskette lever to open position.
c. Remove diskette from storage envelope.
d. Be sure the Write Protect slot in the jacket, as shown in Figure 2-1, is covered if the diskette is to be write protected.
e. Carefully slide diskette into FDD, as shown in Figure 2-1, until jacket is solidly against stops.
f. Turn diskette lever to closed position.
g. Protect the empty envelope from liquids, dust and metallic materials.

### 2.2.2 FLEXIBLE DISKETTE REMOVAL

a. Turn diskette lever to open position.
b. Remove diskette from FDD and put it in its storage envelope.

## 2.3 ERROR RECOVERY

The following paragraphs supply information needed to recover from possible errors in equipment operation.

### 2.3.1 SEEK ERROR

Seek errors will rarely occur unless the stepping rate is significantly exceeded. If a seek error occurs, track location can be recalibrated by repetitive Step Out commands until Track 00 signal is received.

### 2.3.2 WRITE ERROR

To guard against degradation from imperfections in the media, no more than four attempts to write a record should be used when Read After Write errors are encountered. If a record cannot be successfully written in four attempts, the sector or track should be labeled defective and an alternate sector or track assigned. If more than two defective tracks are found the diskette should be replaced.

### 2.3.3 READ ERROR

If a Read error occurs, up to 10 attempts should be made to recover with rereads. If after 10 attempts the data has not been recovered, step the head several tracks away and then reposition to recover the data. Deenergizing the spindle motor when data transfers are not imminent will increase data reliability and extend the diskette life.

## 2.4 DISKETTE HANDLING RECOMMENDATIONS

The recorded diskette may contain vital information. Reasonable care should be exercised in its handling. Longer diskette life and trouble free operation will result if the following recommendations are followed.

a. Do not use a writing device which deposits flakes, for example, lead or grease pencils, when writing on diskette jacket label.
b. Do not fasten paper clips on diskette jacket edges.
c. Do not touch diskette surface exposed by jacket slot.
d. Do not clean diskette in any manner.
e. Keep diskette away from magnetic fields and from ferromagnetic materials that may be magnetized.
f. Return diskette to envelope when removed from FDD.
g. Protect diskette from liquids, dust, and metallic substances at all times.
h. Do not exceed the following storage environmental conditions:

| | |
|---|---|
| Temperature: | 50° F to 125° F (10° C to 51.7° C) |
| Relative Humidity: | 8% to 80% |
| Maximum Wet Bulb: | 85° F (29.4° C) |

i. Store diskette in a box or cabinet when not in use.
j. Remove diskette before applying or removing power to the FDD.

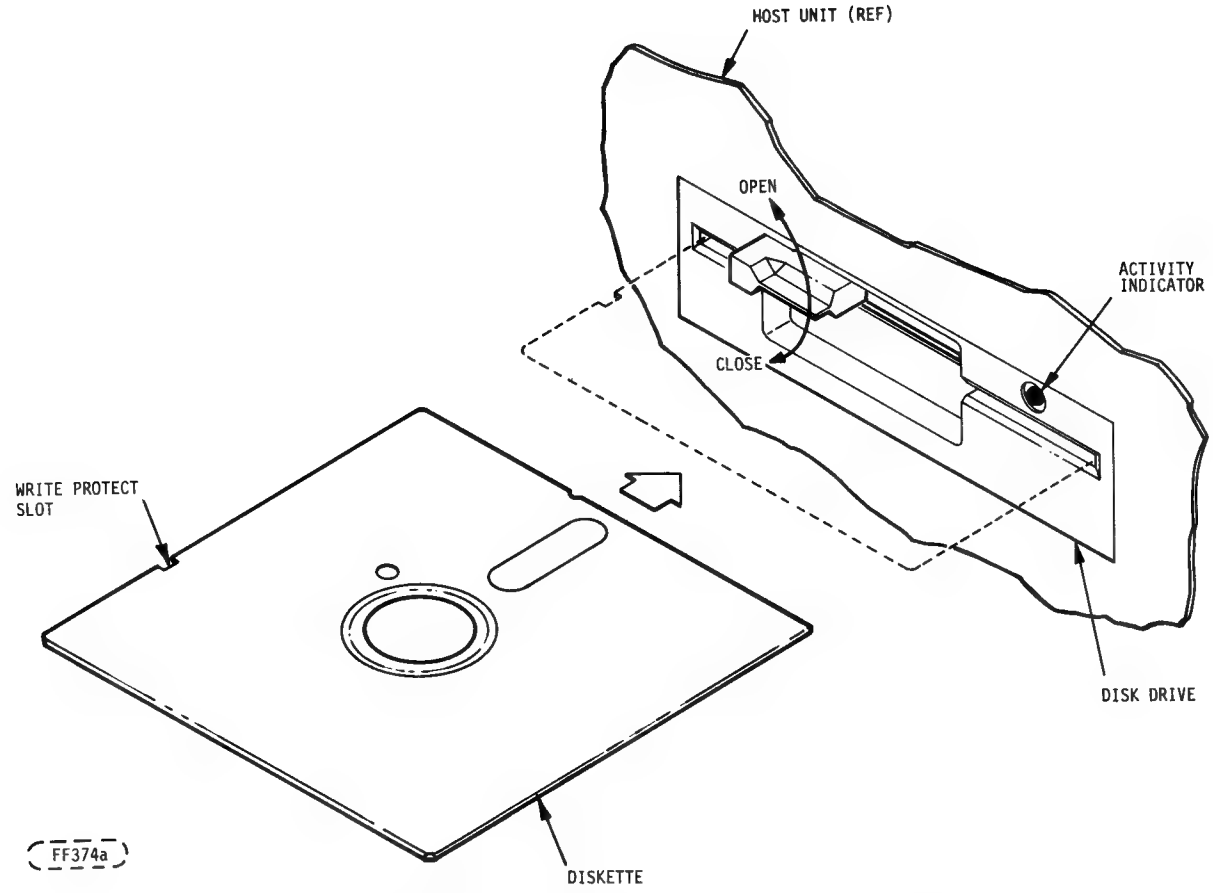



FIGURE 2-1. DISKETTE INSTALLATION

## 3.1 INTRODUCTION

This section provides the information and procedures necessary to put an FDD into operation.

## 3.2 UNPACKING

Unpack FDD as follows:

a. Cut banding and lift top half of styrofoam shell from unit.
b. Lift unit from bottom half of styrofoam shell and remove unit.

During unpacking, care must be used so tools do not damage the unit. As a unit is unpacked, inspect it for possible shipping damage. All claims for this type of damage should be filed promptly with the carrier involved. If a claim is filed for damages, save the original packing materials.

## 3.3 INSTALLATION

Install the FDD in the designated location in the host equipment. Physical characteristics of the FDD are shown in Figure 1-1.

The 9428 has been designed as a component to high standards of design and construction. The product must depend on receiving adequate power and environment from its host equipment to obtain optimum operation, and to comply with applicable industry and governmental regulations. Special attention must be given by the host manufacturers in the areas of safety, power distribution, grounding, shielding, audible noise control, and temperature regulation of the device to insure specified performance and compliance with all applicable regulations.

To assure compliance with FCC Class B regulations, the FDD must be installed within an FCC Class B Certified host system (Personal Computer or other system) and the system installation instructions for the host system must be followed.

Typical Cabling, connectors, etc. are specified in paragraph 3.4 and illustrated in Figure 3-1.

## 3.4 CABLING AND CONNECTORS

Install the DC power cable on connector J2. The connector location and its pin assignments are shown in Figure 3-1. The recommended mating connector for J2 and type of wire are:

| MANUFACTURER | CONNECTOR P/N | CONTRACT P/N | TYPE OF WIRE |
|---|---|---|---|
| AMP | 1-480424-0 | 60617-1 | 18 AWG |

Install the I/O cable on connector J1. The connector location and its pin assignments are shown in Figure 3-1. The I/O cable to connect the host controller to the FDD (or last FDD in a daisychain configuration) should be no longer than 10 feet, and contained within the host cabinet. The recommended mating connector for J1 and type of cable are:

| MANUFACTURER | CONNECTOR P/N | CONTRACT P/N | TYPE OF WIRE |
|---|---|---|---|
| AMP | 583717-5 | 1-583616-1 | Twisted Pair 26 AWG |
| 3M "Scotchflex" | 3463-0001 | NA | Flat Cable |

The Input/Output electrical signal specifications are:

True = Logical One = $V_{out}$ +0.0 V to +0.4 V @ $I_{out}$ = 48 mA (max) sinking
False = Logical Zero = $V_{out}$ +2.5 V to +5.25 V (open collector) @ $I_{out}$ = 250 µA (max) sourcing

## 3.5 INPUT/OUTPUT LINE TERMINATIONS

The FDD provides the capability of terminating the following lines through a resistor pack installed in a DIP socket on the circuit board (see Figure 3-1):

1. MOTOR ON
2. DIRECTION SELECT
3. STEP
4. SIDE SELECT
5. WRITE DATA
6. WRITE GATE
7. DRIVE SELECT (0 THROUGH 3)
8. IN USE

The unit is shipped from the factory with the resistor pack installed. These lines must be terminated for proper operation.

In a multiple (daisychain) drive configuration, only the last FDD in the configuration is to be terminated. All other FDDs on the interface must have the resistor pack removed. In addition, the shunt "MX" (described in Section 4.3.1-h) must be open.

External termination may be used, in which case the host equipment may provide the termination beyond the last FDD. The lines must be terminated to +5 V through 1/4-watt resistors. Total line length must not exceed 10 feet (3.05 m).

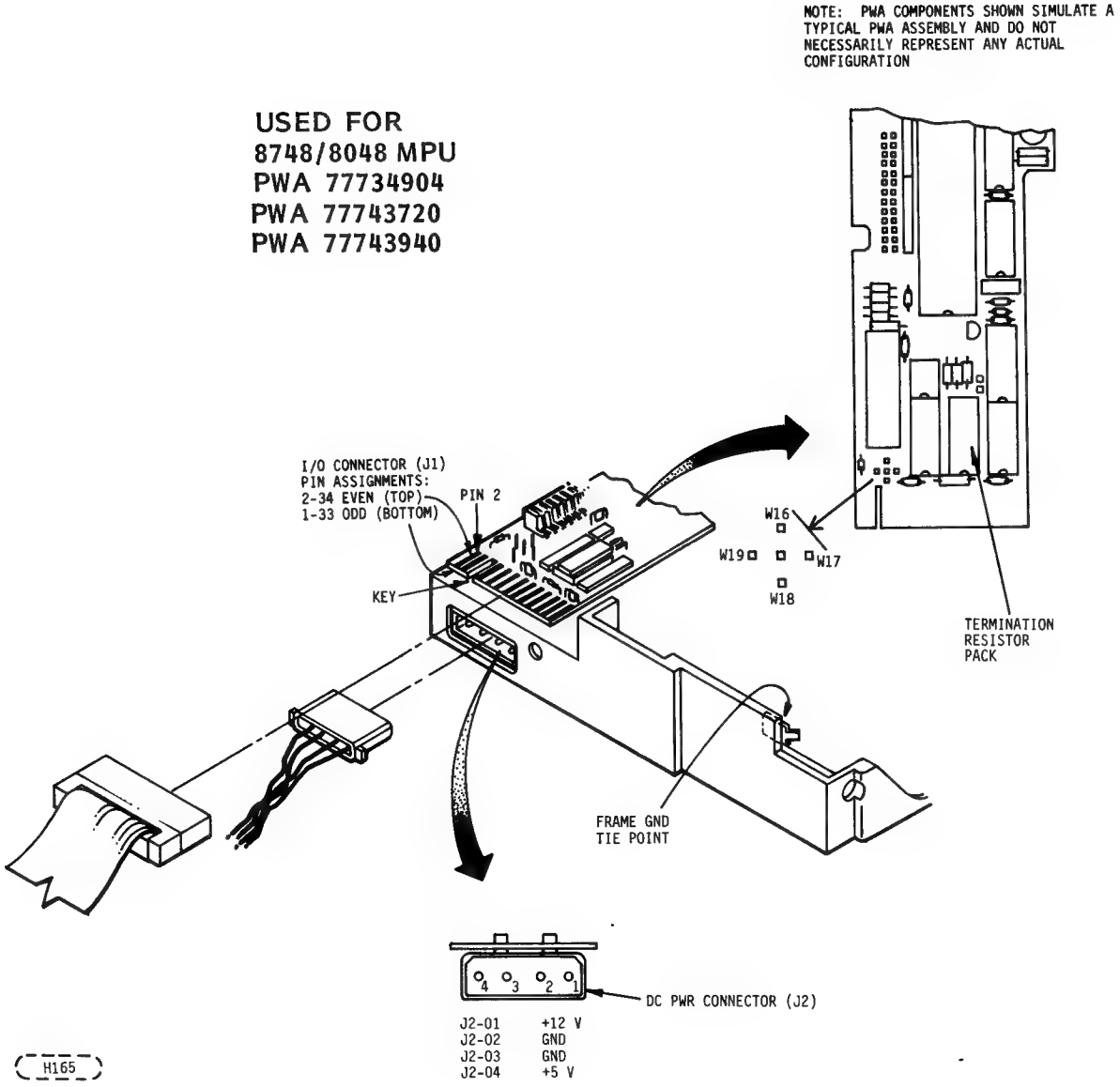



FIGURE 3-1. INPUT/OUTPUT (J1), DC POWER (J2), TERMINATOR, AND SHUNT LOCATION/DESCRIPTION (SHEET 1 OF 2)

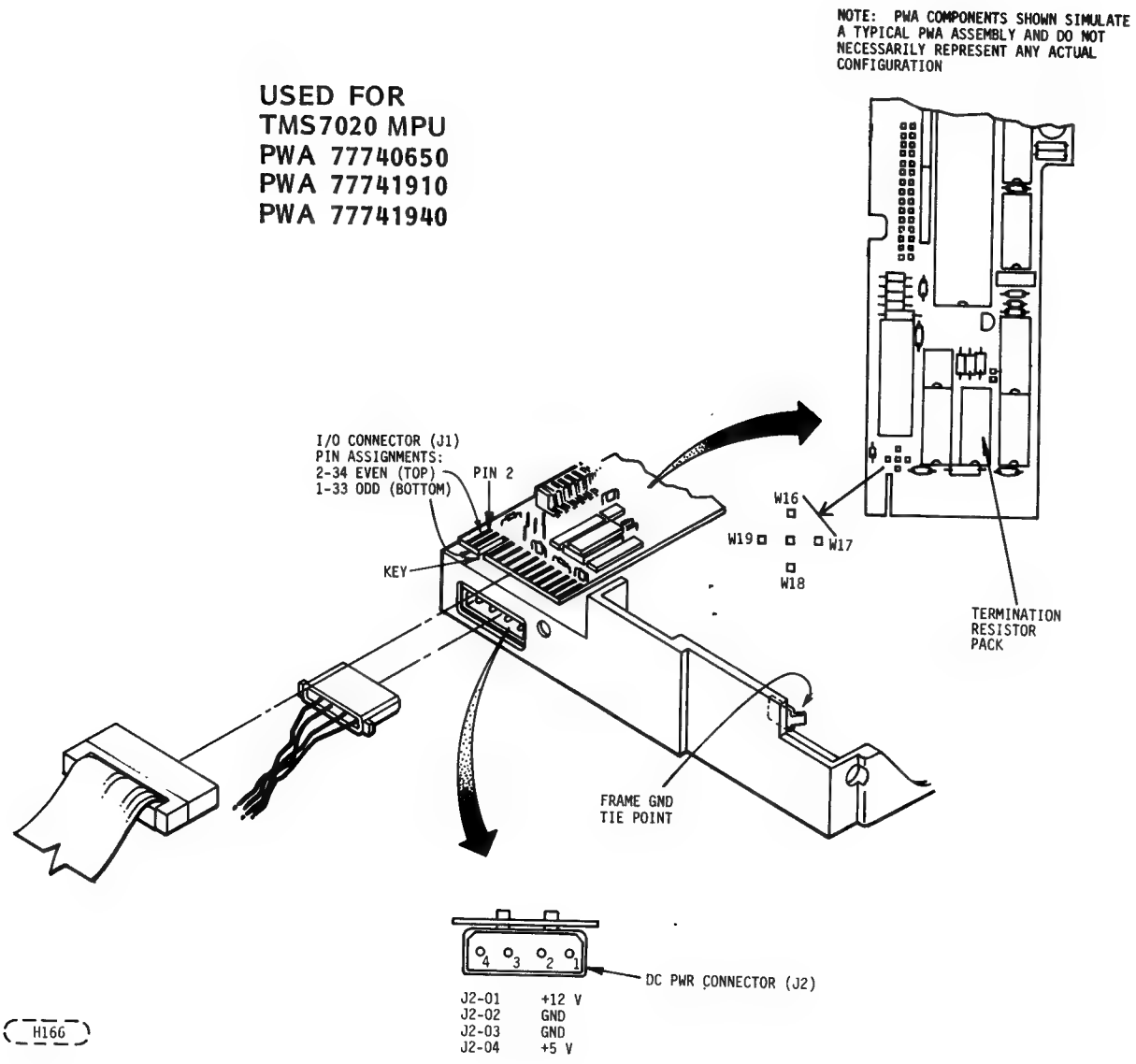



FIGURE 3-1. INPUT/OUTPUT (J1), DC POWER (J2), TERMINATOR, AND SHUNT LOCATION/DESCRIPTION (SHEET 2 OF 2)

# THEORY OF OPERATION 4

## 4.1 INTRODUCTION

The theory of operation of the FDD is divided into two parts. The first part is a general theory of operation. The second part is a more detailed functional description of all major components, both electronic and mechanical, and describes all signals exchanged between the FDD and the controller.

## 4.2 GENERAL DESCRIPTION

The basic function of the FDD is to respond to the commands of the controller to: 1. Receive and generate control signals; 2. Position the Read/Write head to selected tracks; 3. Start/Stop and speed regulate spindle motor; and 4. Write or Read data on the desired surface of the diskette when selected.

Signals received and transmitted by the FDD are shown in Figure 4-1. All signals received by the FDD, except Motor On and In Use, are gated with Drive Select so no stepping, reading, or writing can be performed on an unselected FDD. Motor On is used to start and stop the spindle motor. All signals generated by the FDD are gated with Drive Select so no signals can be transmitted from an unselected FDD.

During the write operation, the selected FDD receives Side Select, Write Gate and Write Data. The Write Gate line remaining high implies a read operation on the surface determined by Side Select. Under these conditions, the FDD will transmit the Read Data signal to the controller. Controller Step commands are received initiating the Track Seek operation on a selected FDD. The FDD transmits Index/Sector pulses as long as it is selected. Also, the selected FDD transmits a Track 00 signal to the controller whenever the Read/Write heads are at Track 00.

Positioning of the carriage mounted Read/Write heads is accomplished by a metal band driven by a stepper motor. Each step command from the user system causes the stepper motor to move the Read/Write heads one track position.

A reading or writing operation begins by placing the Read/Write heads in contact with the diskette at the desired track. To write on the diskette, Write Gate is sent by the controller to condition the write logic. The write current in the head activated by Side Select, reverses polarity simultaneously with the high to low transitions of the Write Data pulses from the controller. The current reversals cause magnetic flux reversals, thus recording data and clock bits on the desired diskette track and surface. Erasure of previously recorded data is simultaneously accomplished during the writing operation. Tunnel erase ensures drive to drive diskette interchangeability.

To read from the diskette, magnetic flux reversals in the recorded data are sensed by the selected Read/Write head. This signal is amplified, digitized, and transmitted to the user system as composite clock and data information.

## 4.3 FUNCTIONAL DESCRIPTION

Refer to Figures 4-1, 5-1 and the Schematic Diagrams, Figure 5-3 for the following discussion.

The FDD is divided into the following major functional areas:

1. Control Logic
2. Write Logic
3. Read Logic
4. Disk Drive
5. Read/Write Head

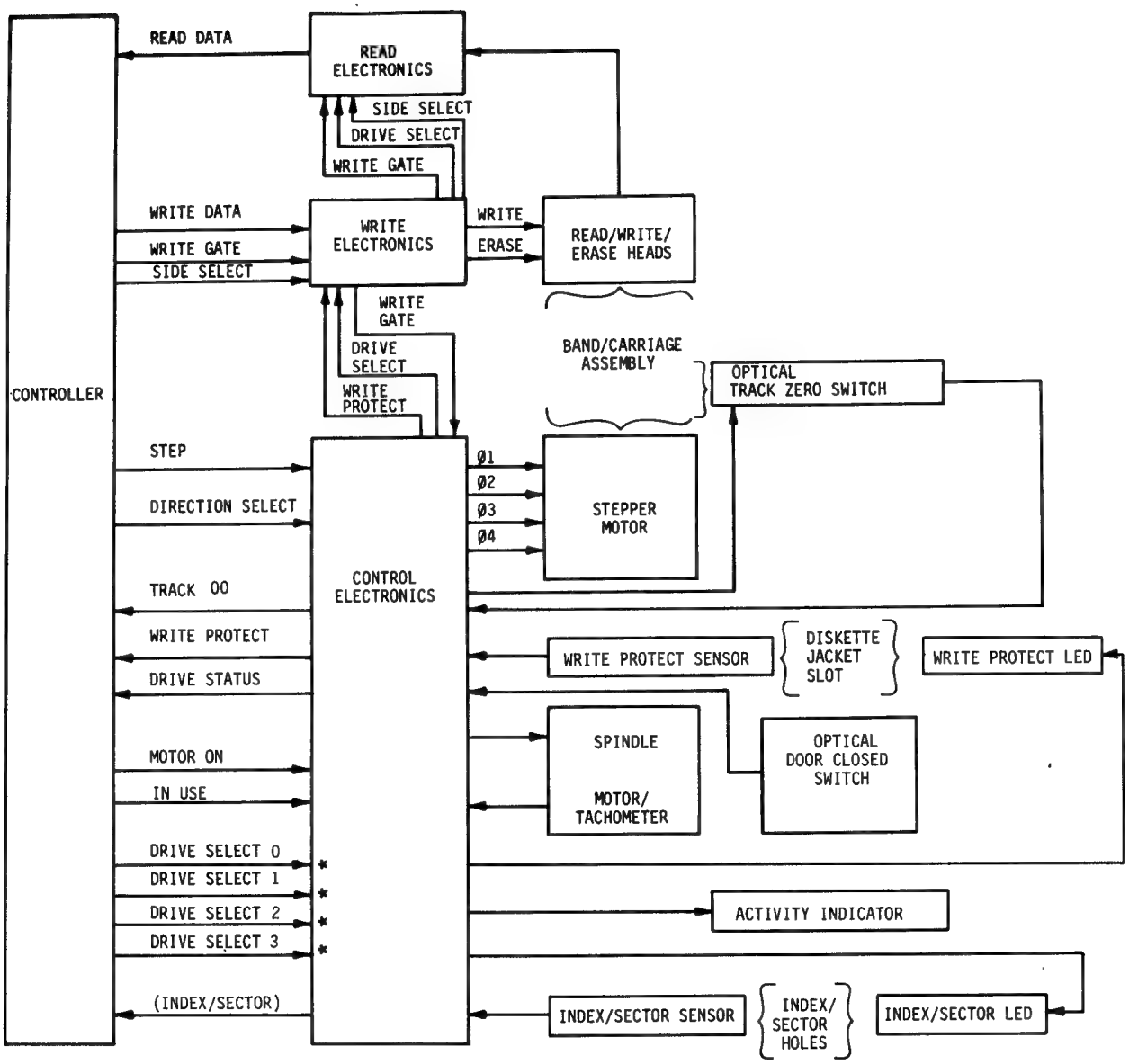



FIGURE 4-1. FUNCTIONAL BLOCK DIAGRAM

## 4.3.1 CONTROL LOGIC

The control logic generates signals that: 1. Activate the spindle motor and control its speed; 2. Step the Read/Write heads in or out upon selection and command of the controller; 3. Protect the diskette from writing if the write protect slot is covered; 4. Indicate when the Read/Write heads are at Track 00; 5. Generate Index/Sector pulses when the diskette is rotating and the FDD is selected; and 6. Provide drive selection of the FDD.

a. The FDD is Ready when the Diskette reaches proper operating speed. The index pulses may be used by the host to determine operating speed. For hard sector diskettes, the controller must separate index pulses from sector pulses.

b. At initial voltage application, phase group A of the stepper motor is energized. Each step command received sequentially energizes one of the four phase groups of the stepper motor.

   Movement of the Read/Write heads is initiated by step commands (high to low transitions on the Step line) from the controller. The heads are stepped one track, toward the spindle (In) or away from the spindle (Out), with each command. A low level on the Direction line causes the Read/Write heads to step toward the spindle, and a high level causes the Read/Write heads to step away from the spindle.

   The phase sequence through which the stepper motor is driven is controlled by the microprocessor. The step signal clocks the counter up or down depending on the status of the direction signal. To inhibit outward steps past Track Zero the counter is disabled at Track Zero when the Direction line is high. A counter in the microprocessor inhibits inward steps past Track 39.

c. The Read/Write heads of a selected FDD will be loaded when the diskette is fully installed and the front panel lever is closed. Closing the front panel lever lowers the upper flexible head onto the diskette. The heads will not load when a diskette is not installed because an interposer prevents the heads from coming together and being damaged.

d. The Write Protect function is selected by an optical switch. The switch is mounted so the absence of a write protect slot in the jacket of the diskette will be detected and gated with Drive Select from the interface. Write Protect inhibits writing on any diskette missing a write protect slot by blocking Write Gate.

e. The Track Zero signal is generated when a flag on the carriage assembly interrupts the Track Zero optical switch and the stepper decode logic is in the phase group A state. When the FDD is selected, the active low Track Zero signal is transmitted to the interface.

f. The Drive Status (READY) signal can indicate (optionally) that the door is closed, or that the door is closed and index has been detected. The door status is generated by a flag on the load arm that interrupts an optical switch on the upper PWA. Details are listed below:

Option A Indicates the door is closed and the drive is selected.

Option B Indicates the door is closed, the drive is selected, and one index pulse has been detected.

Option C Indicates the door is closed, the drive is selected, and two index pulses have been detected.

Note: A loss of index pulses alone after Drive Status is set does not reset Drive Status to a false logic level.

g. The beginning of each diskette track is indicated by an index pulse. The diskette rotates between a light source (LED) and a sensor (photo transistor). When the index hole in the diskette passes over the light source, light is detected by the sensor. The sensor output is detected and transmitted to the controller as the index pulse when the FDD is selected.

The FDD may be used with hard sectored diskettes. The sector pulses are generated along with index pulses on the interface in one composite signal. The controller must separate index pulses from sector pulses for correct operation.

h. The drive select function inhibits all command and status signals except In Use and Motor On. The position of he FDD in a daisychain configuration is determined by the orientation of the shunt in the DS0, DS1, DS2 or DS3 position on the PWA. The "MX" shunt must be removed for daisychain operation. Shunt "MX" may be left in place to cause the FDD always to be selected. This is useful for star configurations.

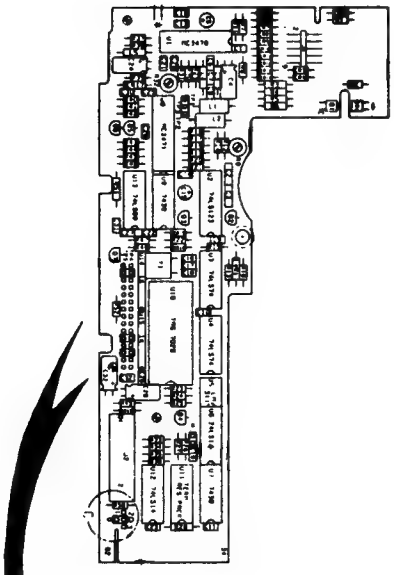
i. For daisychain operation, as detailed in Step "h", shunt "MX" must be removed and the "DS" shunt oriented corresponding to the drive's position in the daisychain. The activity indicator will glow when the drive is selected. Also the activity indicator will glow any time a low level is applied to In Use. In daisychain operation, In Use will make the indicators of all FDD's glow simultaneously.

   For star configured operation, as detailed in Step "h", shunt "MX" is left in place. The Drive Select signal(s) may then be used to make the activity indicator glow for any user defined activity by a low level on the Drive Select line(s) which has (have) the "DS" shunt in place.

TABLE 4-1. 9428 JUMPER OPTIONS (SHEET 1 OF 2)

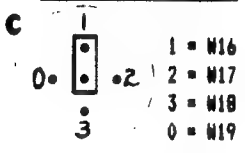
## 9428 JUMPER OPTIONS

### MICROPROCESSOR TYPE: TEXAS INSTRUMENT (TI)



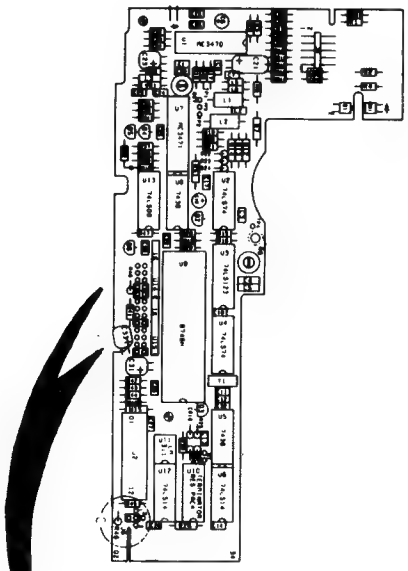
| | | |
|---|---|---|
| TP | * * | TEST PINS, NOT INSTALLED |
| W02 | [* *] | SPINDLE MOTOR CONTROL (SP MTR CNT) |
| W03 | * * | STEP CONTROL, TRACKS PER INCH |
| W04 | * * | TEST PINS, NOT INSTALLED |
| W05 | * * | TEST PINS, NOT INSTALLED |
| W06 | * * | TEST PINS, NOT INSTALLED |
| W07 | * * | TEST PINS, NOT INSTALLED |
| W08 | * * | COMBINATION JUMPER, READY STATUS |
| W09 | * * | COMBINATION JUMPER, READY STATUS |
| W10 | * * | COMBINATION JUMPER, READY STATUS |
| W11 | [* *] | COMBINATION JUMPER, LED CONTROL |
| W12 | * * | COMBINATION JUMPER, LED CONTROL |
| W13 | [* *] | COMBINATION JUMPER, SP MTR CNT |
| W14 | * * | COMBINATION JUMPER, SP MTR CNT |
| W15 | * * | MULTIPLEX OR RADIAL |

DRIVE SELECT JUMPERS



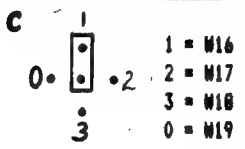

(SEE REVERSE SIDE FOR JUMPER COMBINATION/CONFIGURATION DETAILS)

### MICROPROCESSOR TYPE: INTEL OR NATIONAL SEMICONDUCTOR



| | | |
|---|---|---|
| W02 | * * | TEST PINS, NOT INSTALLED |
| W03 | * * | TEST PINS, NOT INSTALLED |
| W04 | * * | TEST PINS, NOT INSTALLED |
| W05 | [* *] | SPINDLE MOTOR CONTROL (SP MTR CNT) |
| W06 | * * | STEP CONTROL, TRACKS PER INCH |
| W07 | * * | COMBINATION JUMPER, READY STATUS |
| W08 | * * | COMBINATION JUMPER, READY STATUS |
| W09 | * * | COMBINATION JUMPER, READY STATUS |
| W10 | [* *] | COMBINATION JUMPER, LED CONTROL |
| W11 | * * | COMBINATION JUMPER, LED CONTROL |
| W12 | * * | MULTIPLEX OR RADIAL |
| W13 | [* *] | COMBINATION JUMPER, SP MTR CNT |
| W14 | * * | COMBINATION JUMPER, SP MTR CNT |

DRIVE SELECT JUMPERS




(SEE REVERSE SIDE FOR JUMPER COMBINATION/CONFIGURATION DETAILS)

# TABLE 4-1. 9428 JUMPER OPTIONS (SHEET 2 OF 2)

**9428**

| "TI" MICROPROCESSOR | "INTEL" or "NATIONAL" MICROPROCESSOR |
|---|---|

STP = STEP
PLS = PULSE
TPI = TRACKS PER INCH
DDS = DRIVE DESELECT

MO = MOTOR ON
DS = DRIVE SELECT
DC = DOOR CLOSED
IU = IN USE

POR = POWER ON RESET
IDX = INDEX
IN = JUMPER INSTALLED
OUT = JUMPER NOT INSTALLED

| SPINDLE MOTOR 'ON' | | | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) | SPINDLE MOTOR 'ON' | | | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) |
|---|---|---|---|---|---|---|---|
| W14 | W13 | W02 | | W14 | W13 | W05 | |
| OUT | IN | OUT | MO | OUT | IN | OUT | MO |
| OUT | IN | IN | MO or DS | OUT | IN | IN | MO or DS |
| IN | OUT | OUT | DC and MO | IN | OUT | OUT | DC and MO |
| IN | OUT | IN | DC and (MO or DS) | IN | OUT | IN | DC and (MO or DS) |

| "READY" STATUS | | | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) | "READY" STATUS | | | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) |
|---|---|---|---|---|---|---|---|
| W10 | W09 | W08 | | W09 | W08 | W07 | |
| OUT | OUT | OUT | DC | OUT | OUT | OUT | DC |
| OUT | OUT | IN | *DC&(MO or DS)&1 IDX PLS | OUT | OUT | IN | *DC&(MO or DS)&1 IDX PLS |
| OUT | IN | OUT | **DC&(MO or DS)&2 IDX PLS | OUT | IN | OUT | **DC&(MO or DS)&2 IDX PLS |
| OUT | IN | IN | DC & DS & 1 IDX PLS | OUT | IN | IN | DC & DS & 1 IDX PLS |

* IN THIS CONFIGURATION "READY" STAYS TRUE AFTER IT HAS BEEN GENERATED EVEN WHEN (MO or DS) GOES FALSE. "READY" IS RESET ONLY BY OPENING THE DOOR OR POR.

** THIS IS THE HIGHEST (BEST) INTEGRITY "READY" CONFIGURATION. IT IS RESET BY OPENING THE DOOR OR (MO or DS) GOING FALSE. NOTE THAT LOSS OF INDEX PULSES ALONE AFTER "READY" IS SET DOES NOT RESET "READY" TO A FALSE STATUS.

| ACTIVITY LED 'ON' | | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) | ACTIVITY LED 'ON' | | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) |
|---|---|---|---|---|---|
| W12 | W11 | | W11 | W10 | |
| OUT | IN | DS or IU | OUT | IN | DS or IU |
| IN | OUT | DS and IU | IN | OUT | DS and IU |

| TRACKS PER INCH | SET BY MANUFACTURER | TRACKS PER INCH | SET BY MANUFACTURER |
|---|---|---|---|
| W03 | 9428 = W03 OUT | W06 | 9428 = W06 OUT |
| OUT | 48 TPI, 1 STP PLS=2 STPS | OUT | 48 TPI, 1 STP PLS=2 STPS |
| IN | 96 TPI, 1 STP PLS=1 STP | IN | 96 TPI, 1 STP PLS=1 STP |

| MULTIPLEX OR RADIAL | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) | MULTIPLEX OR RADIAL | CONDITIONAL REQUIREMENTS AND CONTROL SIGNAL(S) |
|---|---|---|---|
| W15 | | W12 | |
| OUT | DAISY CHAIN CONFIG. | OUT | DAISY CHAIN CONFIG. |
| IN | RADIAL or STAR CONFIG. | IN | RADIAL or STAR CONFIG. |

WRITE YOUR CONFIGURATION HERE

EXAMPLE: INSTALLED
= W2, W11, W13, W16

* YOUR CONFIGURATION:

W__, W__, W__, W__

WRITE YOUR CONFIGURATION HERE

EXAMPLE: INSTALLED
= W5, W10, W13, W16

* YOUR CONFIGURATION:

W__, W__, W__, W__

### 4.3.2 WRITE LOGIC

A write operation begins with Write Gate and Side Select commands from the controller when the FDD is selected. The commands simultaneously enable the write data bistable and turn on head center tap drivers, thus causing the center tap to go to approximately +12 V, block the input to the read circuit by reverse biasing diodes and after a delay energize the erase winding of the selected head. Data applied to the Write Data input alternately switches a constant write current through the write drivers to the selected head windings.

### 4.3.3 READ LOGIC

Read operation is enabled when the Read/Write heads are loaded on the diskette and Write Gate is inactive. With Write Gate inactive, the data blocking diodes are forward biased, and data sensed by the Read/Write head is amplified. The read signal from the diskette is in the form of a sinewave.

This analog signal is filtered by a passive constant phase filter, differentiated by an active differentiator and coupled to a comparator/logic circuit (a time domain filter) to detect zero crossings and reject noise in the differentiated read signal.

### 4.3.4 DISK DRIVE

Disk drive is accomplished by clamping the diskette between the cone assembly and a motorized spindle. The spindle is rotated at 300 r/min by the spindle motor. The motor is a brushless DC motor controlled by a servo amplifier. Motor speed is adjusted at the factory and should require no readjustment.

### 4.3.5 READ/WRITE HEADS

The Read/Write heads are in direct contract with the diskette during a read or write operation. Since the lower head is rigidly mounted on the carriage assembly, head load is achieved by allowing the upper flexible head, under tension, to force the diskette against the Read/Write heads. The head surfaces are designed for maximum signal transfer to and from the magnetic surfaces of the diskette with minimum head/diskette wear. The tunnel erase gaps DC erase the intertrack area to improve off track signal to noise ratio and permit diskette interchange between FDD units.

## 4.4 CONTROL AND DATA LINE CHARACTERISTICS

All signal lines must be terminated at the receiver. Terminator resistance used is typically 150 ohms. Transmission is by 26 AWG (min.), 120 ohm flat cable or twisted pair (one twist per inch) with a maximum line length of 10 feet. Figure 5-1 shows the timing of typical operations.

### 4.4.1 LOGIC LEVELS

The following definitions will be used throughout this manual:

| | |
|---|---|
| low = Logic 1, Active State | Refers to the low voltage condition +0.4 V Max. |
| high = Logic 0, Inactive State | Refers to the high voltage condition +2.4 V Min. |

### 4.4.2 TRANSMITTER CHARACTERISTICS

The FDD uses the equivalent of TTL 7438 (quad two input open collector drivers) to transmit all control and data signals. Each gate is capable of sinking a current of 48 mA with a maximum output voltage of 0.4 volt.

### 4.4.3 LINE RECEIVER CHARACTERISTICS

The FDD uses the equivalent of the 7414 family for line receivers. The input of each receiver is terminated in 150 ohms.

## 4.4.4 CONTROL AND DATA LINE FUNCTIONS

The signals described in Table 4-2 are shown relative to a point of origin in Figure 4-1.

TABLE 4-2. INPUT/OUTPUT LINES (SHEET 1 OF 2)

| SIGNAL | FUNCTION |
|---|---|
| INPUT LINES | |
| STEP | A one-microsecond minimum logic 1 level pulse on this line causes the heads to move one track as determined by the direction line. Twenty milliseconds maximum is required after a logic 0 to logic 1 transition (when the motion begins) before the carriage is stable. |
| DIRECTION SELECT | A logic 1 level on this line and step pulse causes the heads to move one track inward toward center of the diskette. A logic 0 level on this line and step pulse causes the heads to move one track outward from the center of the diskette. The level must be stable one microsecond before and one microsecond after the logic 0 to logic 1 transition of STEP. |
| MOTOR ON | A logic 1 level on this line starts the DC motor which rotates the diskette. The logic 1 level must be initiated 500 milliseconds before initiating a read or write operation to allow the spindle to come up to speed and stabilize.<br><br>For increased head and media life, this signal should be at a logic 0 whenever a data transfer operation is not in process or pending. |
| WRITE GATE | To enable the FDD write driver, this line is held at a logic 1 level.<br><br>To disable the FDD write drive and enable the FDD read circuitry, this line is held at logic 0. One millisecond maximum is reqired after a write operation before read data is stable. |

TABLE 4-2. INPUT/OUTPUT LINES (SHEET 2 OF 2)

| SIGNAL | FUNCTION |
|---|---|
| INPUT LINES | |
| WRITE DATA | This line carries the composite write clock and coded data information to the FDD. The write clock and write data pulses must be 250 nanoseconds minimum to 2100 nanoseconds maximum in length and are true at the logic 1 level. Information to be recorded on the diskette is derived from the transition of each pulse from logic 0 to logic 1. |
| DRIVE SELECT | On this line a logic 1 level with shunt "DS0, DS1, DS2, or DS3" present enables the FDD interface. |
| SIDE SELECT | A logic 1 level on this line enables upper Head 1, a logic 0 level on this line enables lower Head 0, for read and/or write operations. A 200 microsecond delay is required after this level is changed before read data is valid or the Write Gate is switched to a logic 1. |
| IN USE | A logic 1 level will make the Activity Indicator glow. |
| OUTPUT LINES | |
| INDEX | A logic 1 pulse indicates detection of index and/or sector holes in the rotating diskette. The interval between index pulses is an indication of the rotating speed. Sector pulses indicate rotational position of the diskette. |
| TRK 00 | A logic 1 level indicates the heads are positioned over Track 00. |
| WRT PROTECT | Logic 1 level indicates the write protect slot on the diskette is covered, and the diskette cannot be written on. |
| READ DATA | This line carries unseparated data and clock information. A logic 1 level pulse of one microsecond corresponds to a data or clock bit read from the diskette. |
| DRIVE STATUS | A logic 1 level indicates one of he conditions detailed in 4.3.1.f has occurred. |

## 5.1 DIAGRAMS

This section contains the PWA documentation and related timing diagrams.

Figure 5-1 shows timing diagrams which illustrate signal time relationships during read, write, step in, and step out operations. Figure 5-2 lists J1 and J2 pin assignments. Figures 5-3A through 5-3D include the Data Control PWA schematic and assembly drawings for the types of PWAs used in this FDD. Be sure to identify the type before proceeding. Figures 5-4A through 5-4C include the Motor Control PWA schematics and assembly drawings.

## 5.2 MAINTENANCE AIDS

### 5.2.1 INTRODUCTION

This section contains detailed information on the logic circuits used in the FDD. The logic consists of two types of circuits: discrete component and integrated circuits (IC). Integrated circuits are contained within a single chip. Discrete component circuits are composed of individually identifiable resistors, capacitors, transistors, etc.

### 5.2.2 PHYSICAL DESCRIPTION (LOGIC)

All components are mounted on two PWAs. The PWAs contain both IC and discrete component circuits.

### 5.2.3 LOGIC SYMBOLOGY

Logic signals that are "active hi" have the suffic/+L attached to their names, and logic signals that are "active lo" have the suffix/-L attached. For example, the signal WRITE GATE/-L will be "hi" (logic 0) when the unit is not commanded to write. WRITE GATE/-L will go "active lo" (logic 1) when the unit is commanded to write data on the diskette. Signals that do not have/+L or /-L appended to their names are not logic signals.

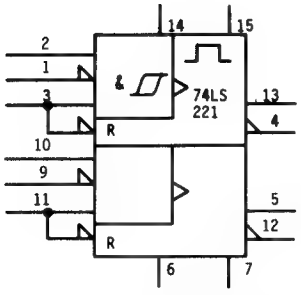
Annotation used with logic storage devices is as follows:

S = Set input to bistable device
R = Reset (Clear) input to bistable device
G = Gate input has no direct action on circuit, but must be present before inputs (and/or outputs) are able to function. If more than one gate is used a numeric suffix is added (G1, G2, etc.)

D = Identifies a signal which requires the presence of another signal to perform its function.
C = Strobe pulse. Usually used to gate "D" inputs into a bistable device.
T = Toggle input. Bistable device changes state each time "T" assumes its specified state.
J = J outputs conditioned by leading edge of dynamic toggle (G).
K = K output conditioned by leading edge of dynamic toggle (G).

Some of the logic symbols are illustrated and described in Table 5-1.

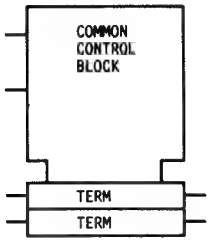
# TABLE 5-1. LOGIC SYMBOLOGY



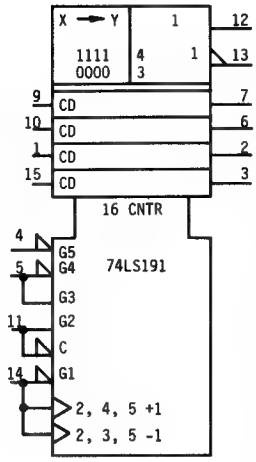

THE 74LS221 IS A DUAL MONOSTABLE MULTIVIBRATOR WITH SCHMITT TRIGGER INPUTS. THE TWO SECTIONS ARE INDEPENDENT EXCEPT FOR A COMMON POWER SOURCE.

TRIGGERING OCCURS AT A PARTICULAR INPUT VOLTAGE LEVEL AND IS NOT DIRECTLY RELATED TO TRANSITION TIME OF THE INPUT SIGNAL. HYSTERESIS INPUT ALLOWS JITTER FREE TRIGGERING.

PIN 2 (10) GENERATES A TRIGGER ON ITS POSITIVE GOING SLOPE OR INHIBITS THE TRIGGER WHEN LOW. PIN 1 (9) GENERATES A TRIGGER ON ITS NEGATIVE GOING SLOPE OR INHIBITS THE TRIGGER WHEN HIGH. PIN 3 (11) ENABLES THE TRIGGER WHEN HIGH OR INHIBITS THE TRIGGER AND RESETS THE MONOSTABLE WHEN LOW. PINS 13 (5) AND 4 (12) ARE RESPECTIVELY THE POSITIVE AND NEGATIVE GOING PULSE OUTPUTS. EXTERNAL R-C COMPONENTS CONNECTED TO PINS 14 AND 15 (6 AND 7) DETERMINE THE DURATION OF THE OUTPUT PULSE.




INPUTS TO THE COMMON CONTROL BLOCK AFFECT EVERY TERM IN THE ARRAY. INPUTS TO EACH TERM AFFECT ONLY THAT TERM.




THE 74LS191 IS A SYNCHRONOUS UP/DOWN COUNTER. EACH STAGE HAS AN INPUT AND AN OUTPUT PIN AS FOLLOWS:

| INPUT | STAGE | OUTPUT |
|---|---|---|
| 9 | D | 7 |
| 10 | C | 6 |
| 1 | B | 2 |
| 15 | A | 3 |

WHEN OPERATED AS A COUNTER, STAGE A IS THE LEAST SIGNIFICANT BIT.

PIN 4 WHEN LOW (G5) "SELECTS" THE IC AND ENABLES IT TO RESPOND TO OTHER CONTROL SIGNALS.

PIN 11 WHEN LOW (C) ENABLES PARALLEL INPUT. ALL FOUR STAGES ASSUME THE STATE OF THE INPUT PINS. WHEN PIN 11 IS HIGH (G2) DATA INPUTS ARE DISABLED AND THE COUNTER IS ENABLED.

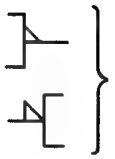
PIN 5 WHEN LOW (G4) PERMITS THE COUNTER TO INCREMENT. PIN 5 WHEN HIGH (G3) PERMITS THE COUNTER TO DECREMENT.

PIN 14 (G1) IS THE "CLOCK" INPUT. WHEN THE COUNTER IS ENABLED, A LOW TO HIGH TRANSITION OF PIN 14 CAUSES THE COUNTER TO CHANGE STATE.

PIN 13 IS THE "RIPPLE CLOCK OUT" TO PERMIT COUNTERS TO BE CASCADED.

PIN 12 INDICATES MAX/MIN WHICH ANTICIPATES THE "RIPPLE CLOCK".

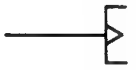

TEST POINT



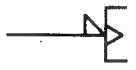
LOGIC POLARITY INDICATOR- "LO" ACTIVE STATE.

IMPLIED SIGN INDICATOR- ABSENCE OF AN N SIGN INDICATOR IMPLIES A NON-INVERTING SIGNAL RELATIVE TO OTHER IMPLIED SIGN SIGNAL LINES. EFFECT IS THE SAME AS THE USE OF P SIGN INDICATOR INTERNALLY.


SIGN INDICATOR-USED TO INDICATE INVERSION RELATIVE TO IMPLIED SIGN SIGNAL LINES.



DYNAMIC INPUT ACTIVE DURING THE TRANSITION FROM LOW TO HIGH STATE



DYNAMIC INPUT ACTIVE DURING THE TRANSITION FROM HIGH TO LOW STATE

| | |
|---|---|
| X/Y | BINARY LEVEL CONVERTER |
| I | "OR" GATE |
| & | "AND" GATE |
|  | SCHMITT TRIGGER - CIRCUIT WITH PULSE SHAPING CAPABILITIES |
| Σ∞ | SUMMING AMPLIFIER |
| X → Y | CODER-INPUT CODE X CONVERTED TO OUTPUT CODE Y |

FF235

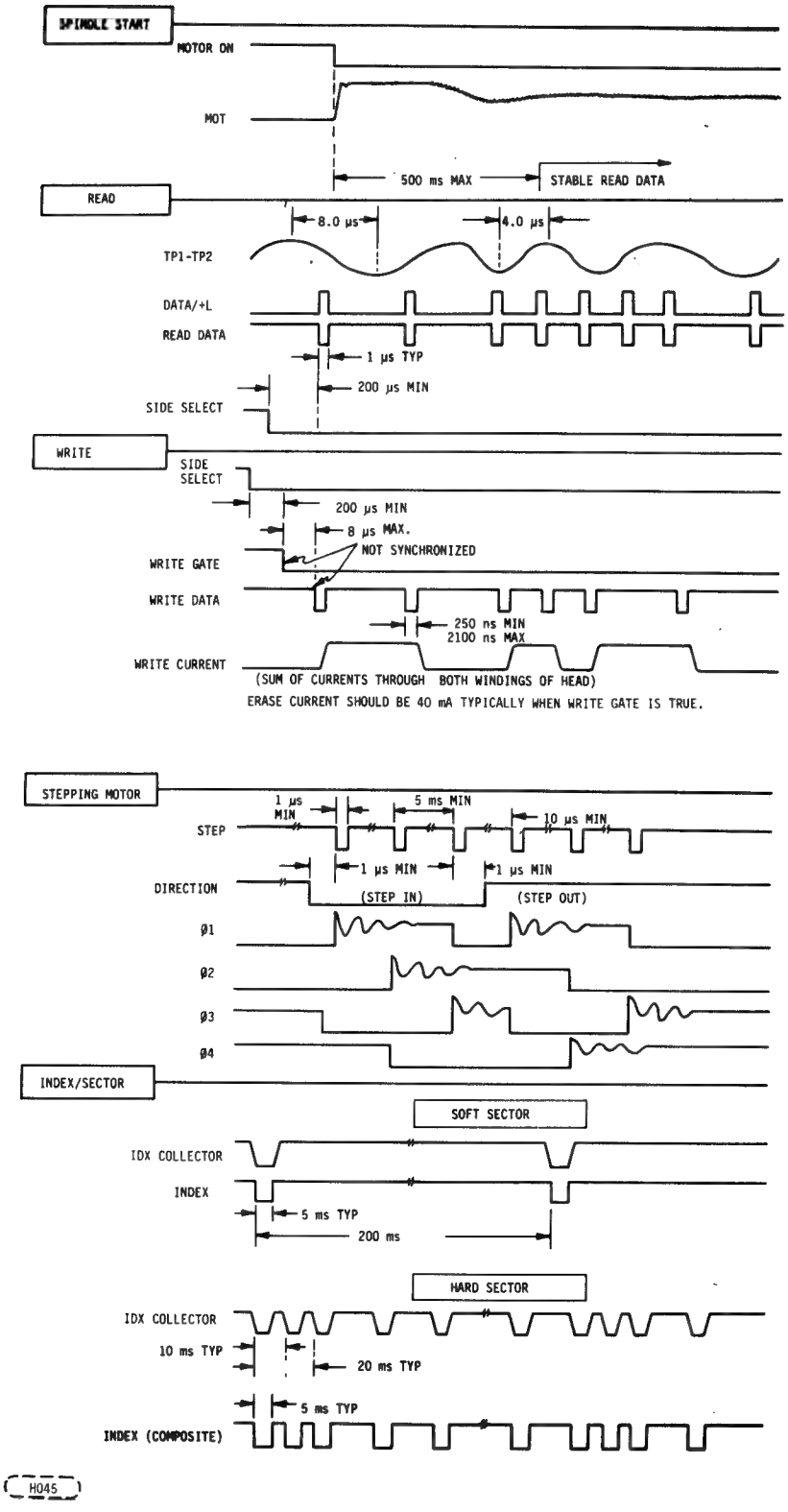
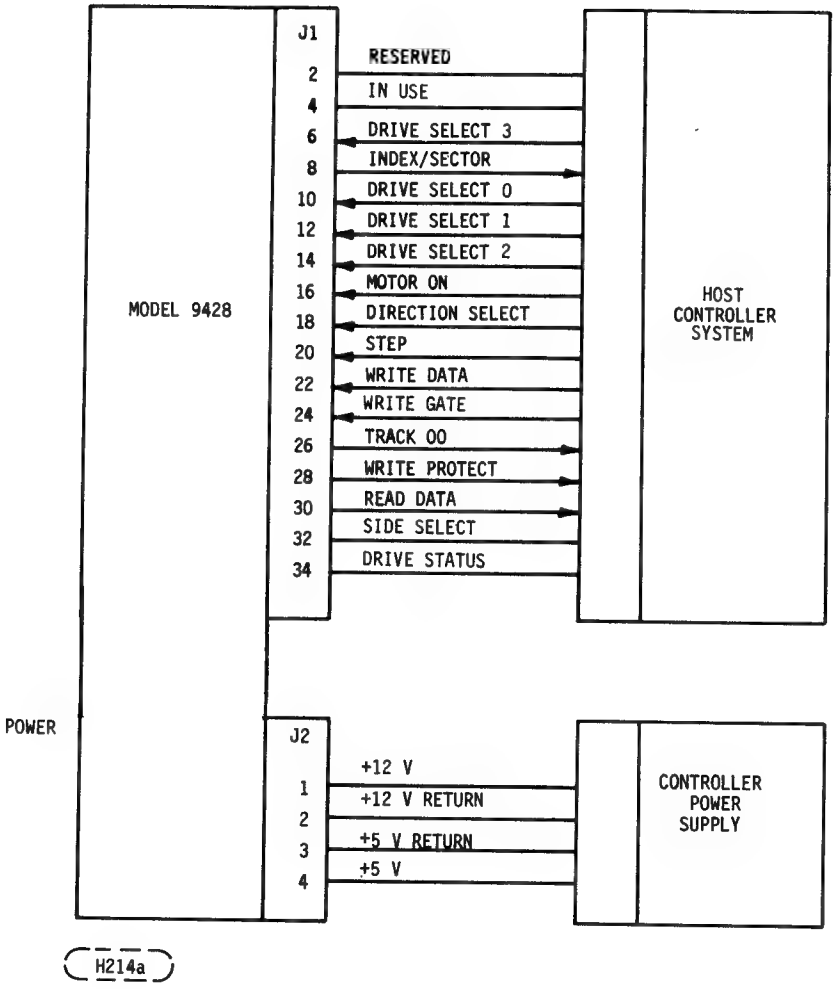



FIGURE 5-1. TIMING DIAGRAM




**ALL J1 ODD NUMBER PINS DC GROUND.**

FIGURE 5-2. J1 AND J2 PIN ASSIGNMENTS

## TABLE 5-2. CONFIGURATION INDEX OF MAJOR ASSEMBLIES

| HPC # | DATA* PWA | MOTOR PWA | SPINDLE MOTOR | HEAD ASSEMBLY** |
|---|---|---|---|---|
| 77740000 | A | 77738651 | 77671895 | 77740444 |
| 77740001 | A | 77738651 | 77671895 | 77740444 |
| 77740002 | NONE | NONE | 77671895 | 77741420 |
| 77740003 | A | 77740185 | 77671895 | 77740444 |
| 77740004 | A | 77740185 | 77671895 | 77740444 |
| 77740005 | A | 77738651 | 77671895 | 77740444 |
| 77740006 | A | 77738651 | 77671895 | 77740444 |
| 77740007 | A | 77738651 | 77671895 | 77740444 |
| 77740008 | B | 77741571 | 77671896 | 77741420 |
| 77740009 | B | 77741571 | 77671896 | 77741420 |
| 77740010 | C | 77741571 | 77671896 | 77741420 |
| 77740011 | A | 77743656 | 77671895 | 77740444 |
| 77740012 | A | 77743661 | 77671895 | 77740444 |
| 77740013 | A | 77743661 | 77674895 | 77740444 |
| 77740014 | B | 77743670 | 77671896 | 77741420 |
| 77740015 | 77740650 | 77743656 | 77671895 | 77740444 |
| 77740016 | C | 77741571 | 77671896 | 77741420 |
| 77740017 | C | 77743785 | 77671896 | 77741420 |
| 77740018 | C | 77743785 | 77671896 | 77741420 |
| 77740054 | 77743720 | 77743661 | 77671895 | 77741420 |
| 77740055 | 77740650 | 77743661 | 77671895 | 77740444 |
| 77740056 | 77741940 | 77743661 | 77671895 | 77741420 |
| 77740057 | C | 77743661 | 77671895 | 77741420 |
| 77740058 | 77741940 | 77743656 | 77671895 | 77741420 |
| 77740059 | C | 77743656 | 77671895 | 77741420 |
| 77740060 | C | 77743661 | 77671895 | 77741420 |
| 77740061 | C | 77741571 | 77671896 | 77741420 |
| 77740062 | B | 77741571 | 77671896 | 77741420 |
| 77740076 | C | 77743661 | 77671895 | 77741420 |
| 77740077 | C | 77743661 | 77671895 | 77741420 |
| 77740078 | C | 77743656 | 77671895 | 77741420 |

* A = 77740650 or 77734904
B = 77741910 or 77743940
C = 77741940 or 77743720

** 77741420 may be substituted for 77740444

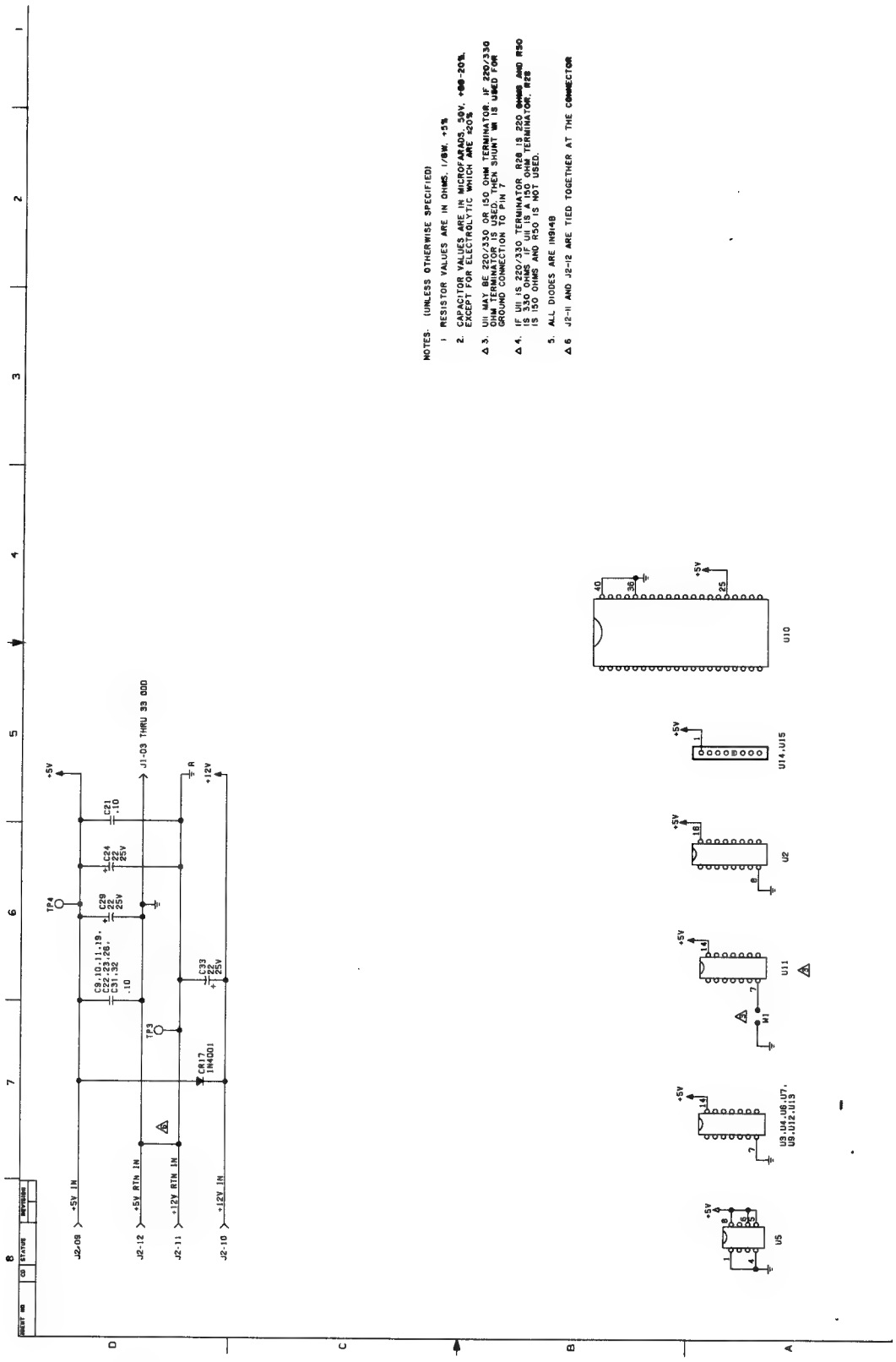



FIGURE 5-3A. DATA CONTROL PWA 77740650 (SHEET 1 OF 4)

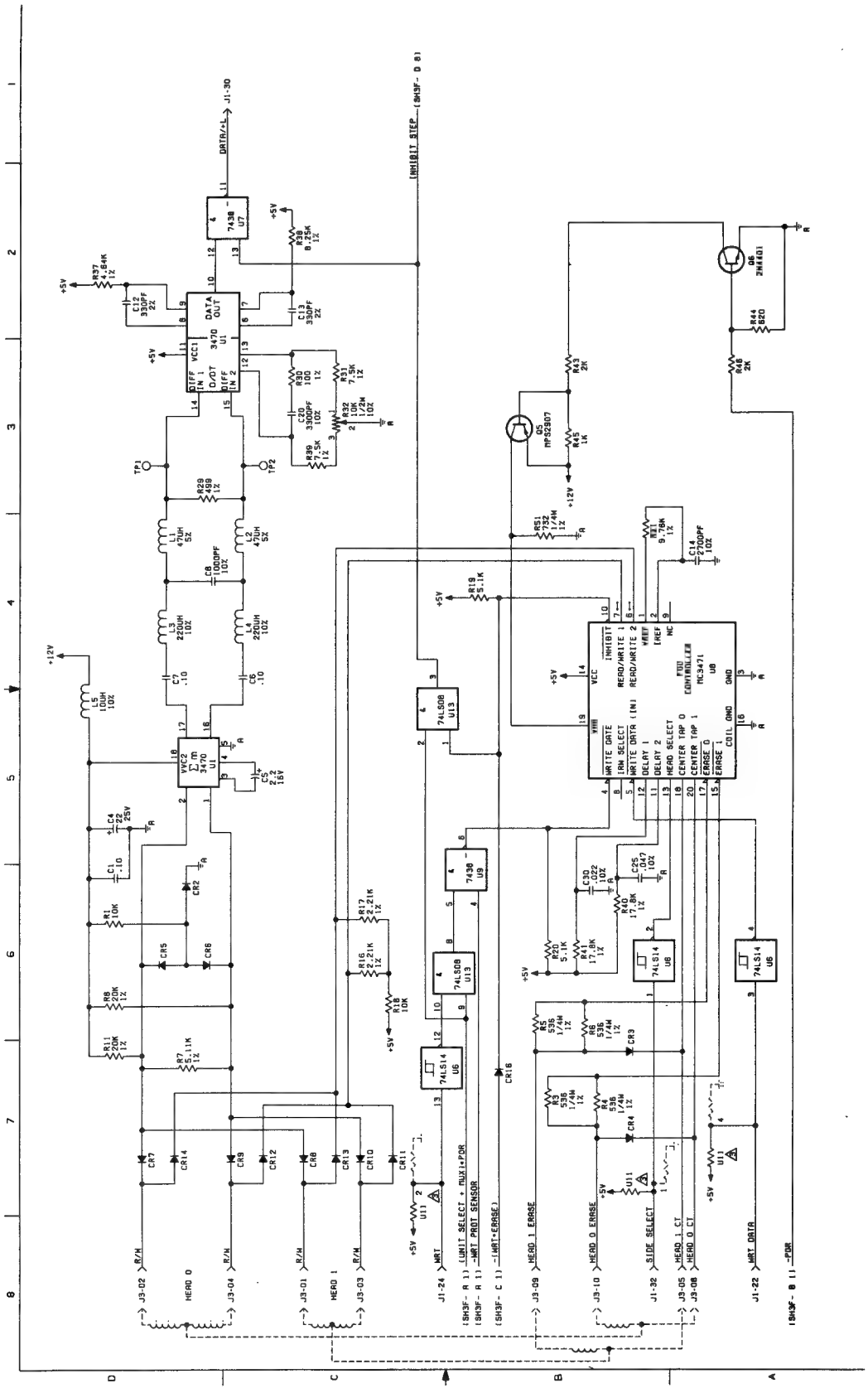


FIGURE 5-3A. DATA CONTROL PWA 77740650 (SHEET 2 OF 4)

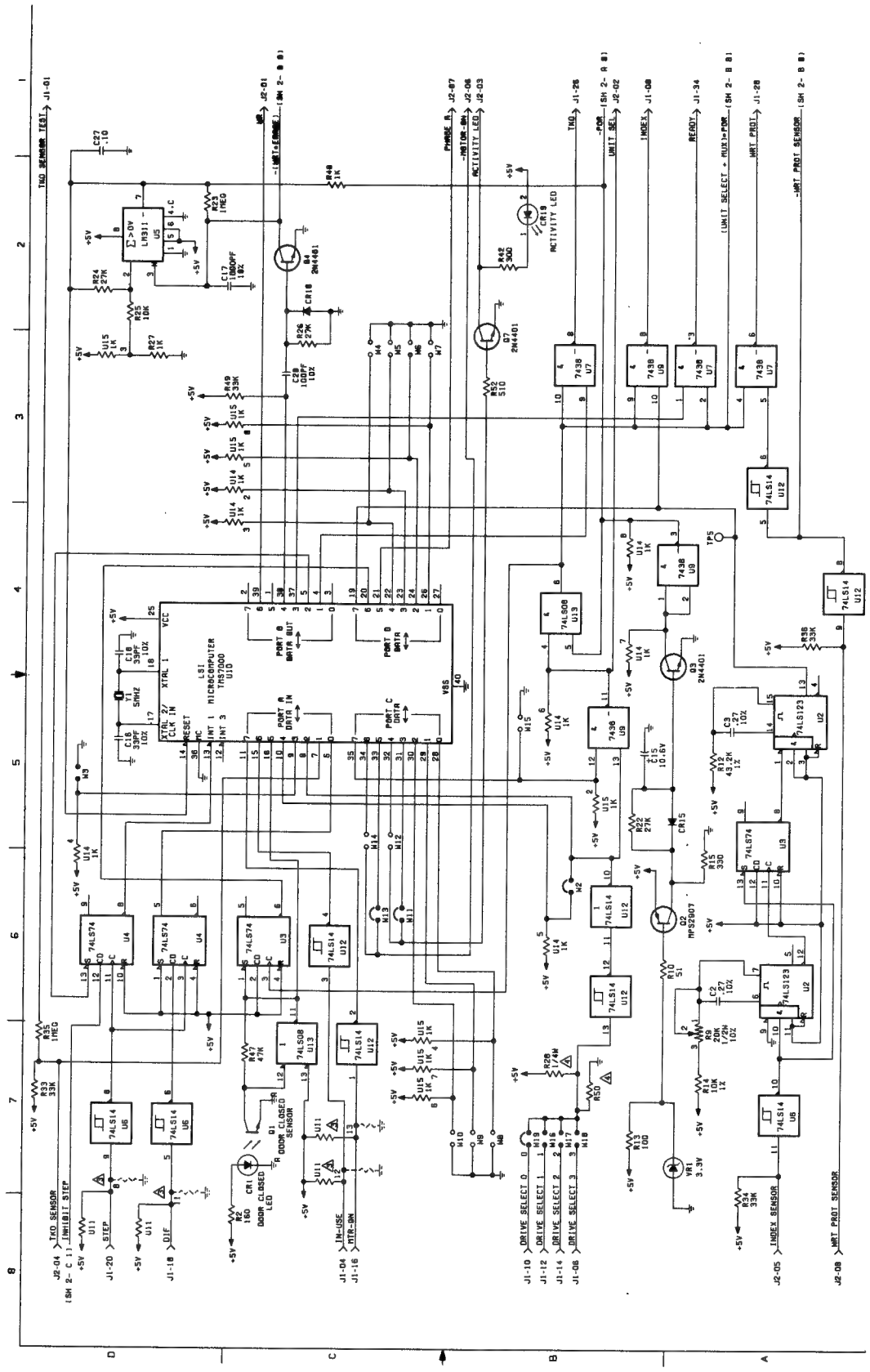
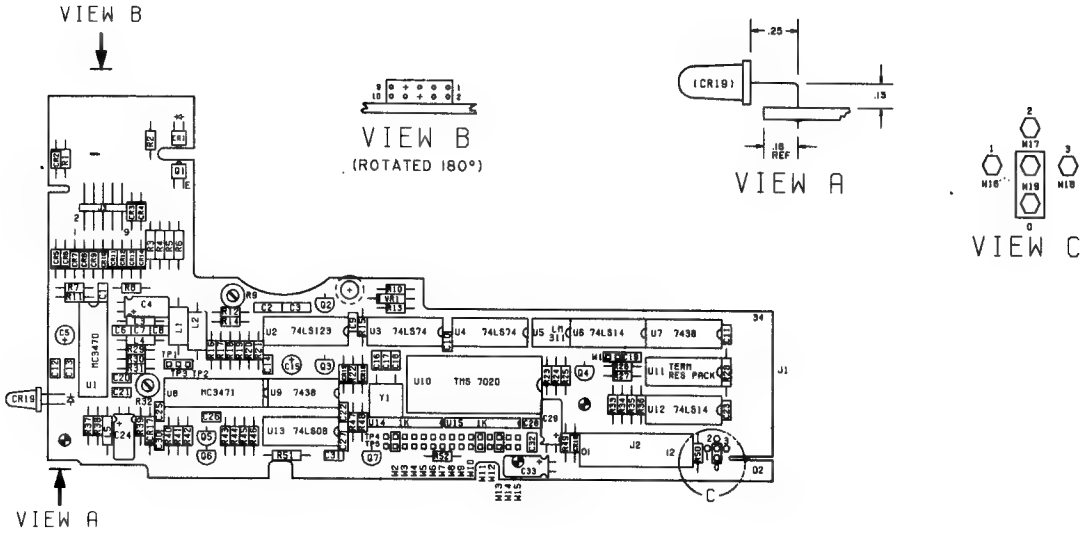


FIGURE 5-3A. DATA CONTROL PWA 77740650 (SHEET 3 OF 4)




| | |
|---|---|
| CR1 | = SEP8507-2 |
| CR2 - CR16, CR18 | = IN914B |
| CR17 | = IN4001 |
| CR19 | = LED |
| VR1 | = 3.3V 5% |
| Q1 | = SDP8407-1 |
| Q2, Q5 | = MPS2907 |
| Q3, Q4, Q6, Q7 | = 2N4401 |

FIGURE 5-3A. DATA CONTROL PWA 77740650 (SHEET 4 OF 4)

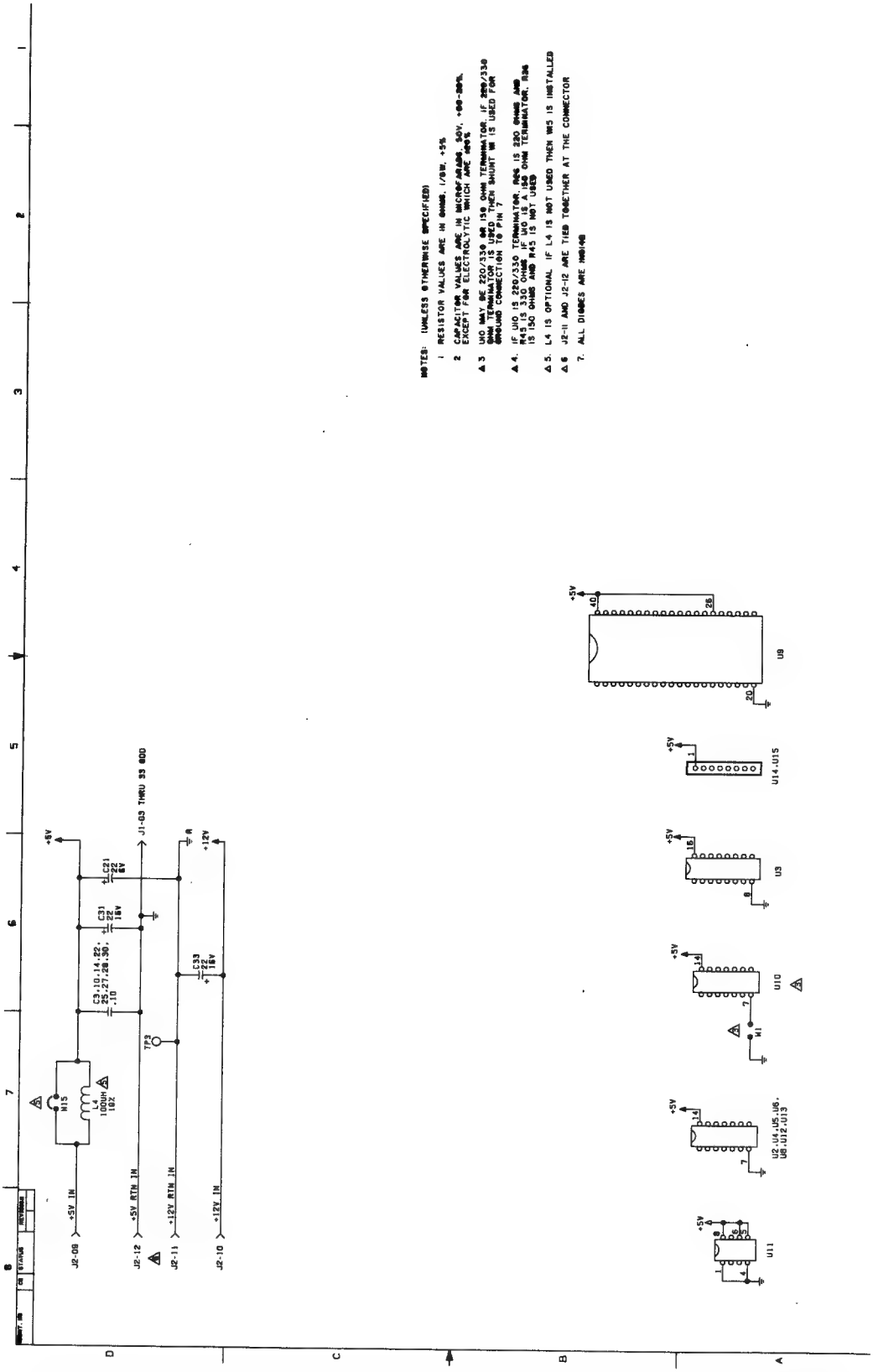


FIGURE 5-3B. DATA CONTROL PWA 77734904 (SHEET 1 OF 4)

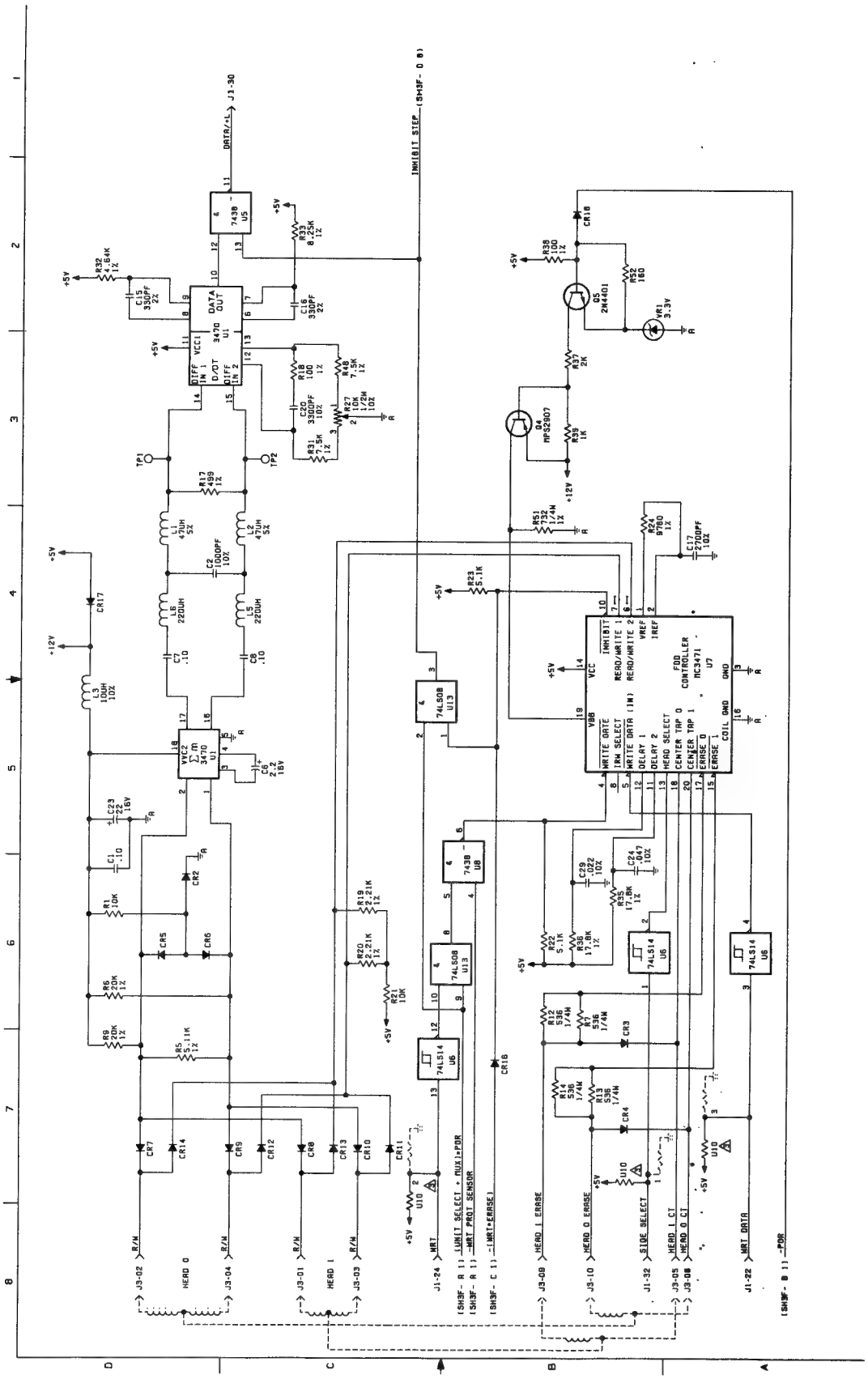


FIGURE 5-3B. DATA CONTROL PWA 77734904 (SHEET 2 OF 4)

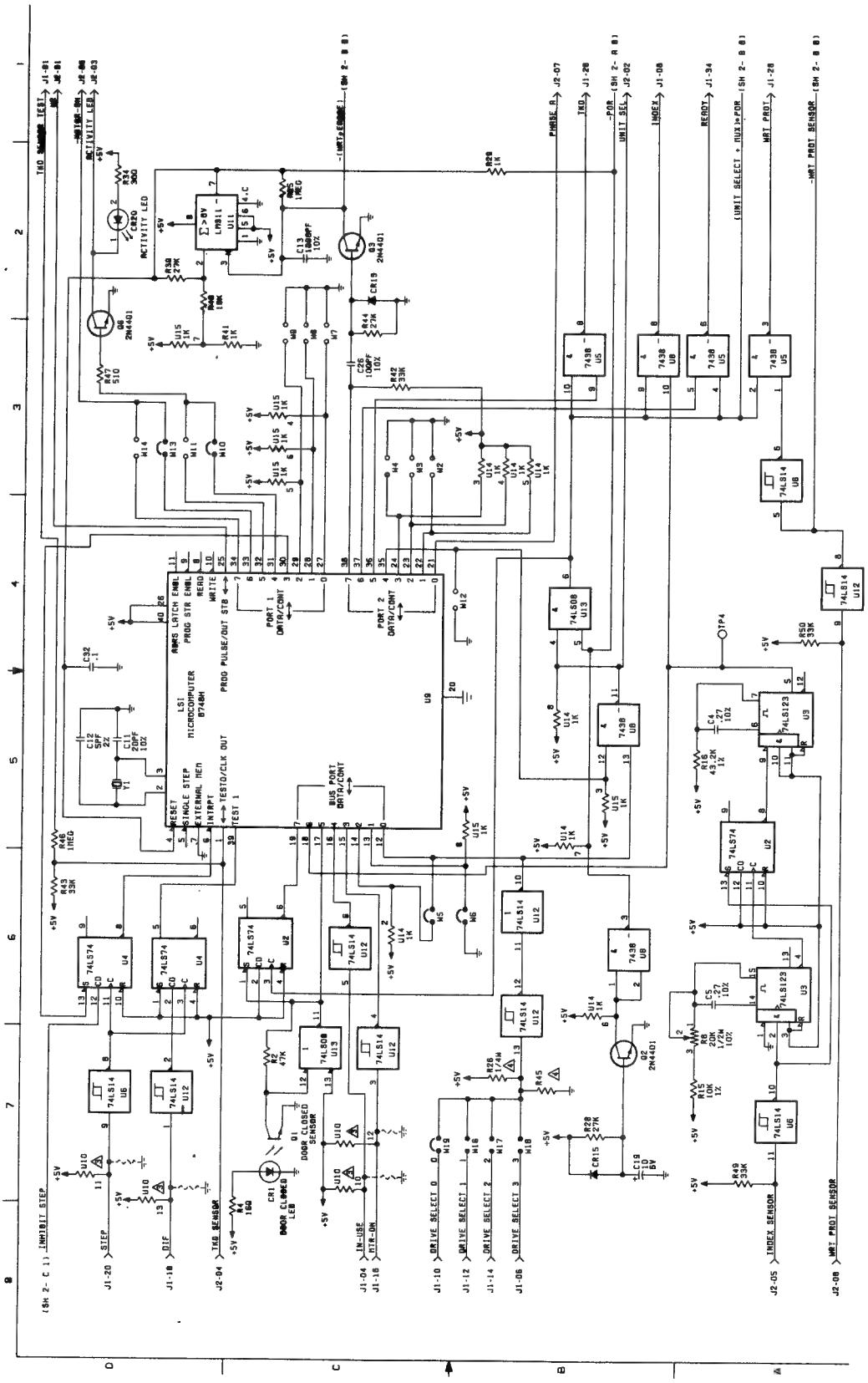
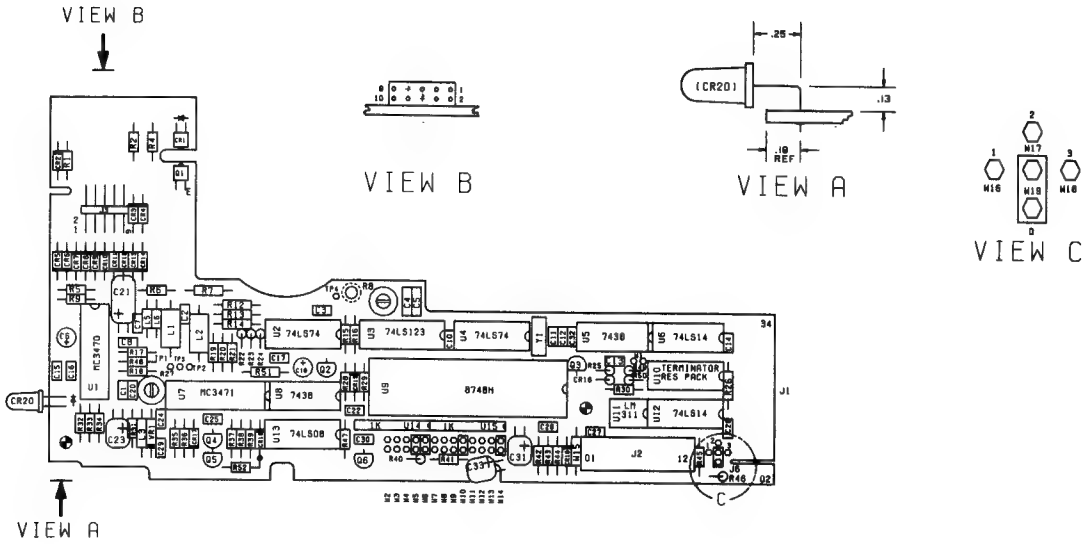


FIGURE 5-3B. DATA CONTROL PWA 77734904 (SHEET 3 OF 4)




| | |
|---|---|
| CR1 | = SEP8507-2 |
| CR2 - CR16, CR18, CR19 | = IN914B |
| CR17 | = IN4001 |
| CR20 | = LED |
| VR1 | = 3.3V 5% |
| Q1, Q4 | = MPS2907 |
| Q2, Q3, Q5, Q6 | = 2N4401 |

FIGURE 5-3B. DATA CONTROL PWA 77734904 (SHEET 4 OF 4)

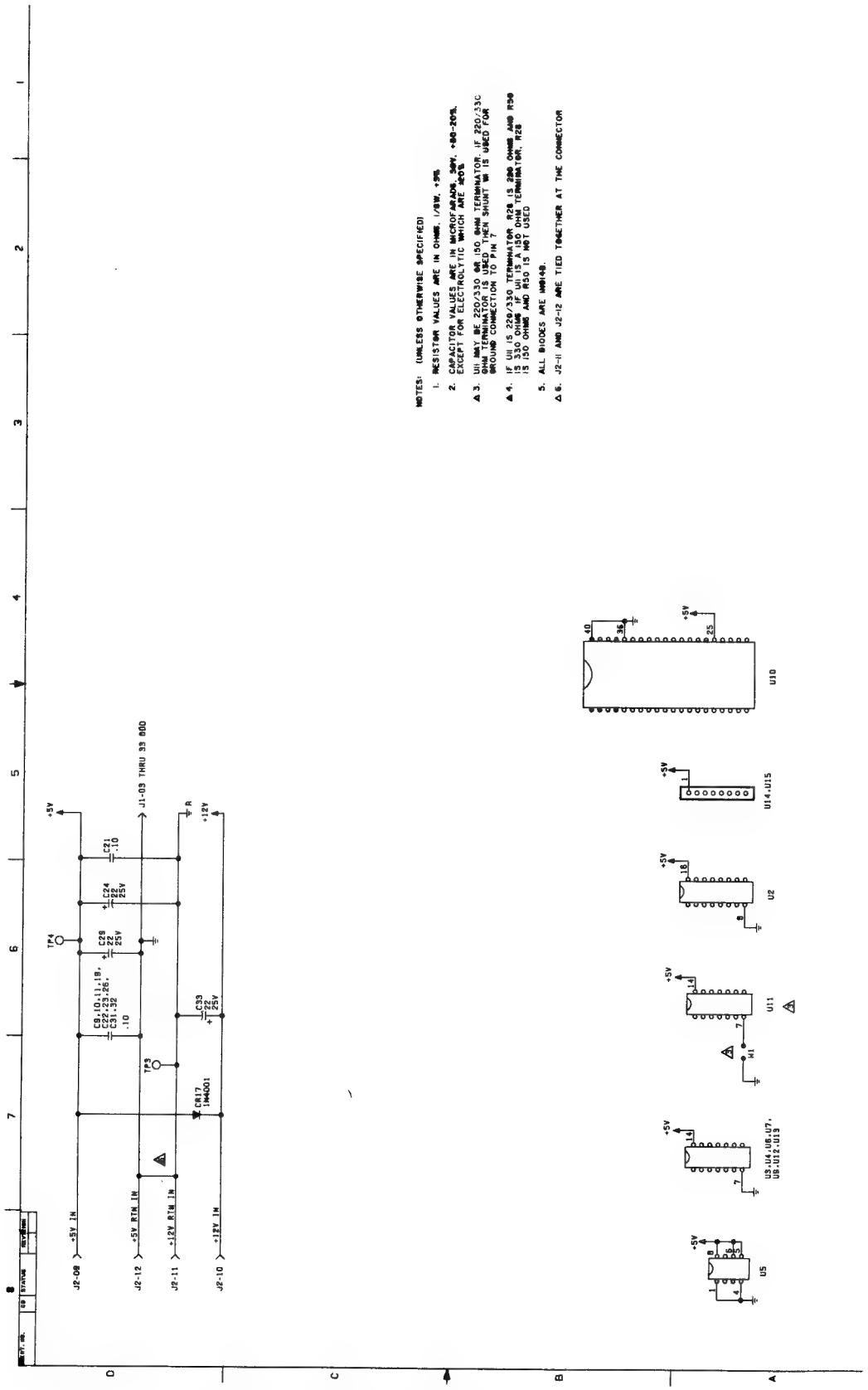



FIGURE 5-3C. DATA CONTROL PWA'S 77741910 AND 77741940 (SHEET 1 OF 5)

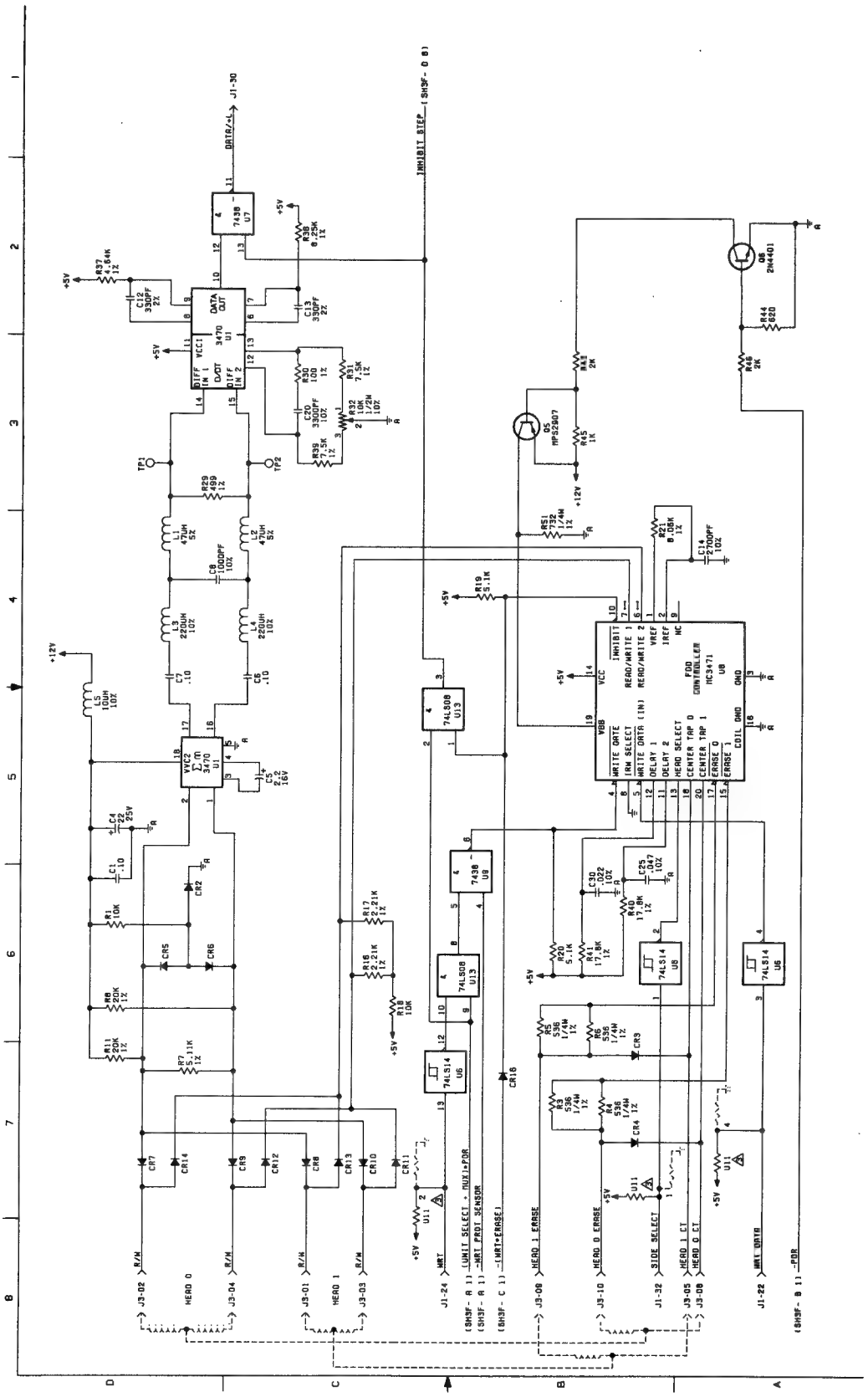


FIGURE 5-3C. DATA CONTROL PWA'S 77741910 AND 77741940
(SHEET 2 OF 5)

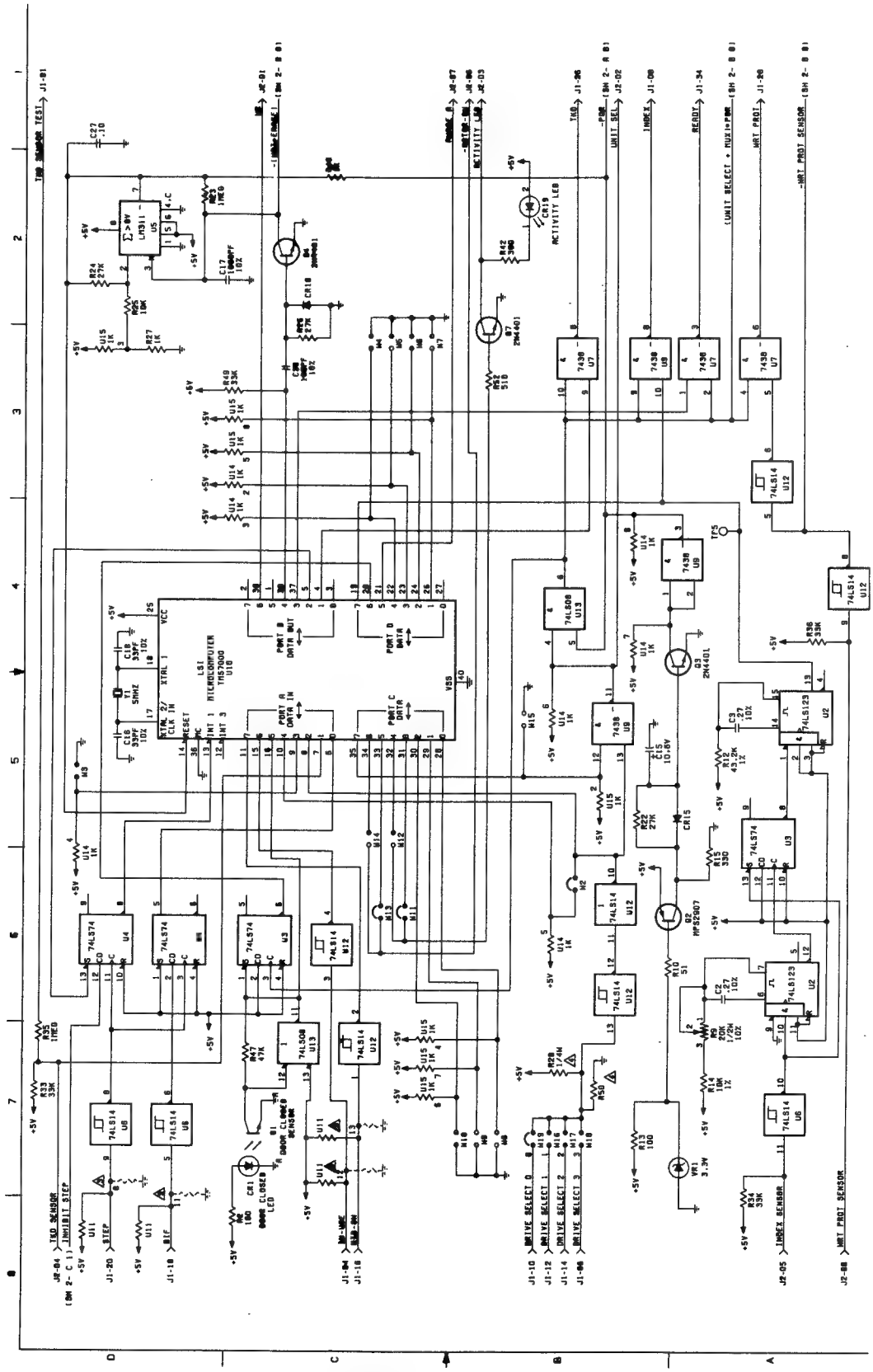
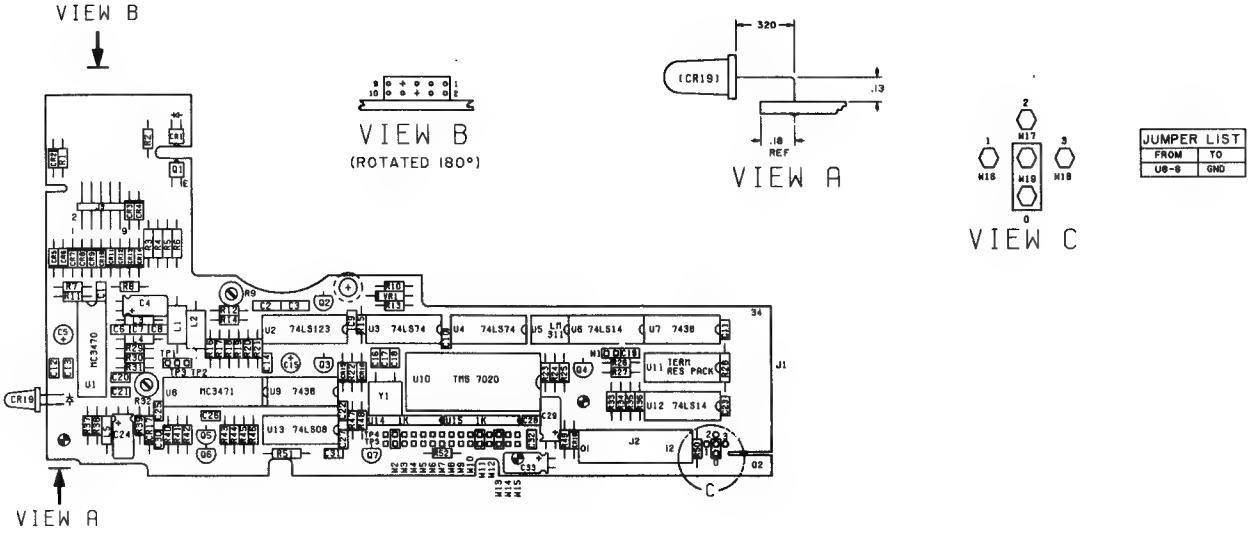
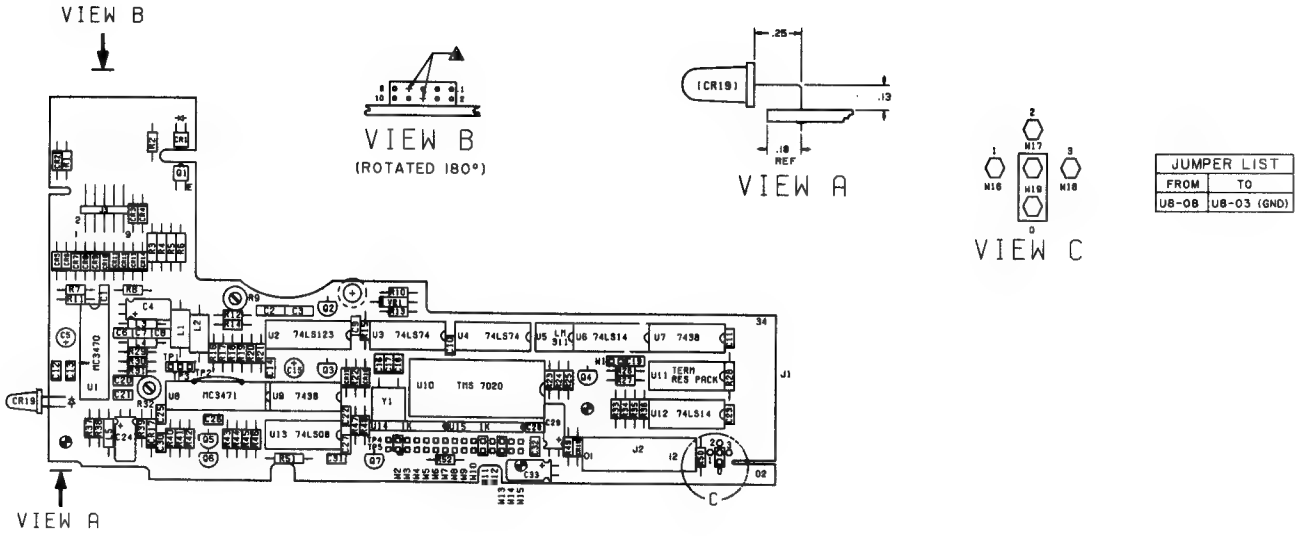


FIGURE 5-3C. DATA CONTROL PWA'S 77741910 AND 77741940
(SHEET 3 OF 5)




| | |
|---|---|
| CR1 | = SEP8507-2 |
| CR2 - CR16, CR18 | = IN914B |
| CR17 | = IN4001 |
| CR19 | = LED |
| VR1 | = 3.3V 5% |
| Q1 | = SDP8407-1 |
| Q2, Q5 | = MPS2907 |
| Q3, Q4, Q6, Q7 | = 2N4401 |

FIGURE 5-3C. DATA CONTROL PWA 77741910
(SHEET 4 OF 5)




| | |
|---|---|
| CR1 | = SEP8507-2 |
| CR2 - CR16, CR18 | = IN914B |
| CR17 | = IN4001 |
| CR19 | = LED |
| VR1 | = 3.3V 5% |
| Q1 | = SDP8407-1 |
| Q2, Q5 | = MPS2907 |
| Q3, Q4, Q6, Q7 | = 2N4401 |

FIGURE 5-3C. DATA CONTROL PWA 77741940
(SHEET 5 OF 5)

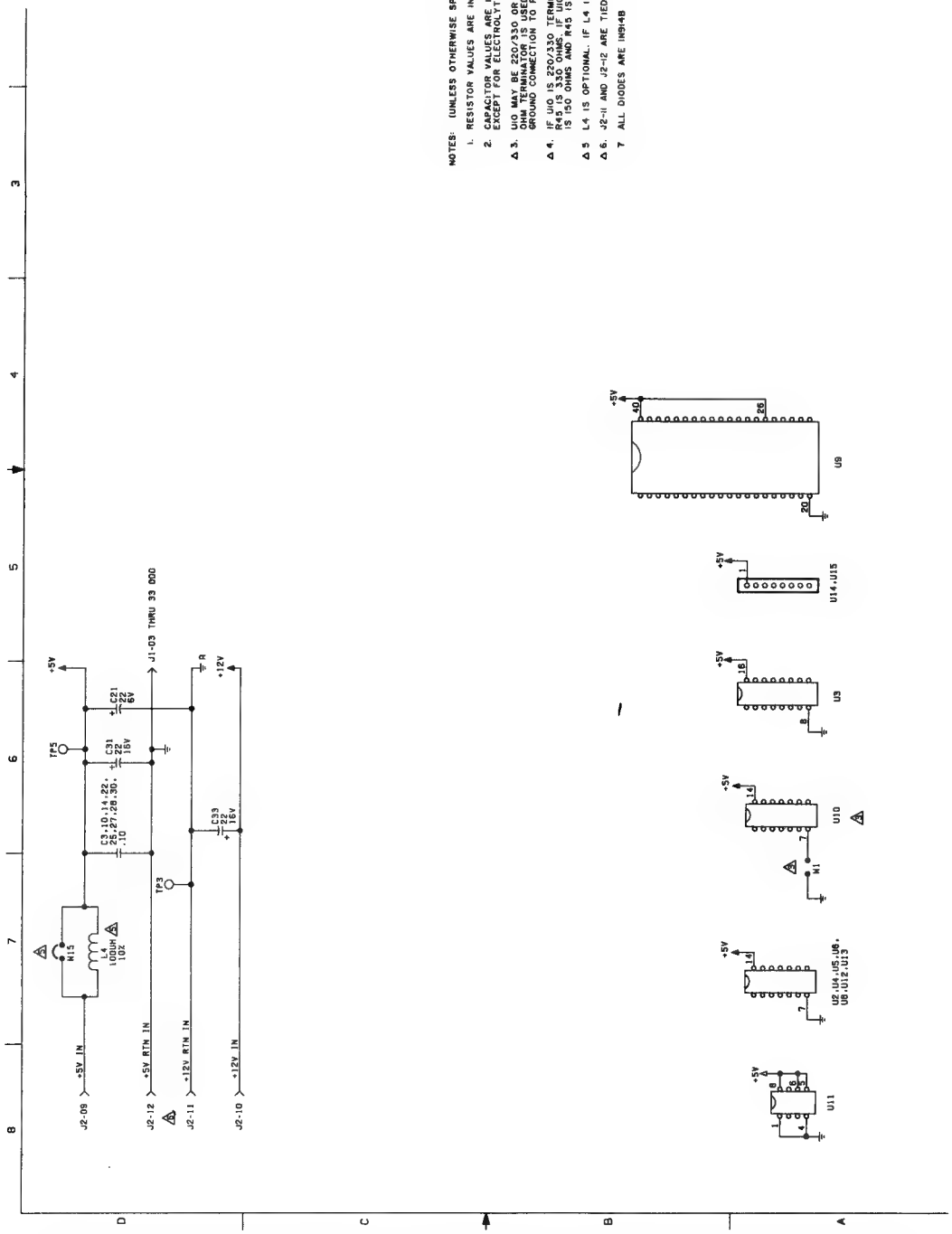



FIGURE 5-3D. DATA CONTROL PWA's 77743720 AND 77743940 (SHEET 1 OF 5)

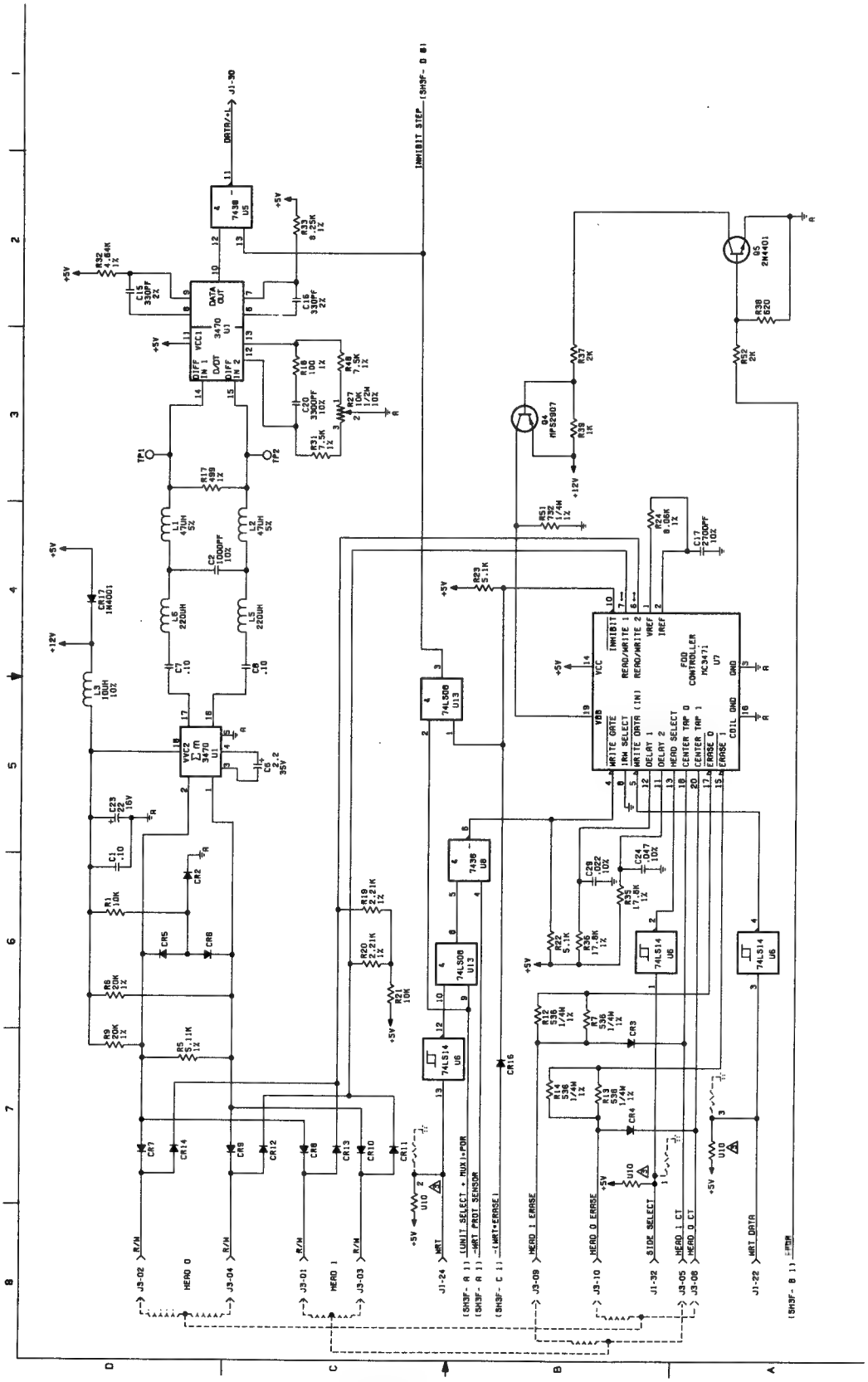


FIGURE 5-3D. DATA CONTROL PWA'S 77743720 AND 77743940
(SHEET 2 OF 5)

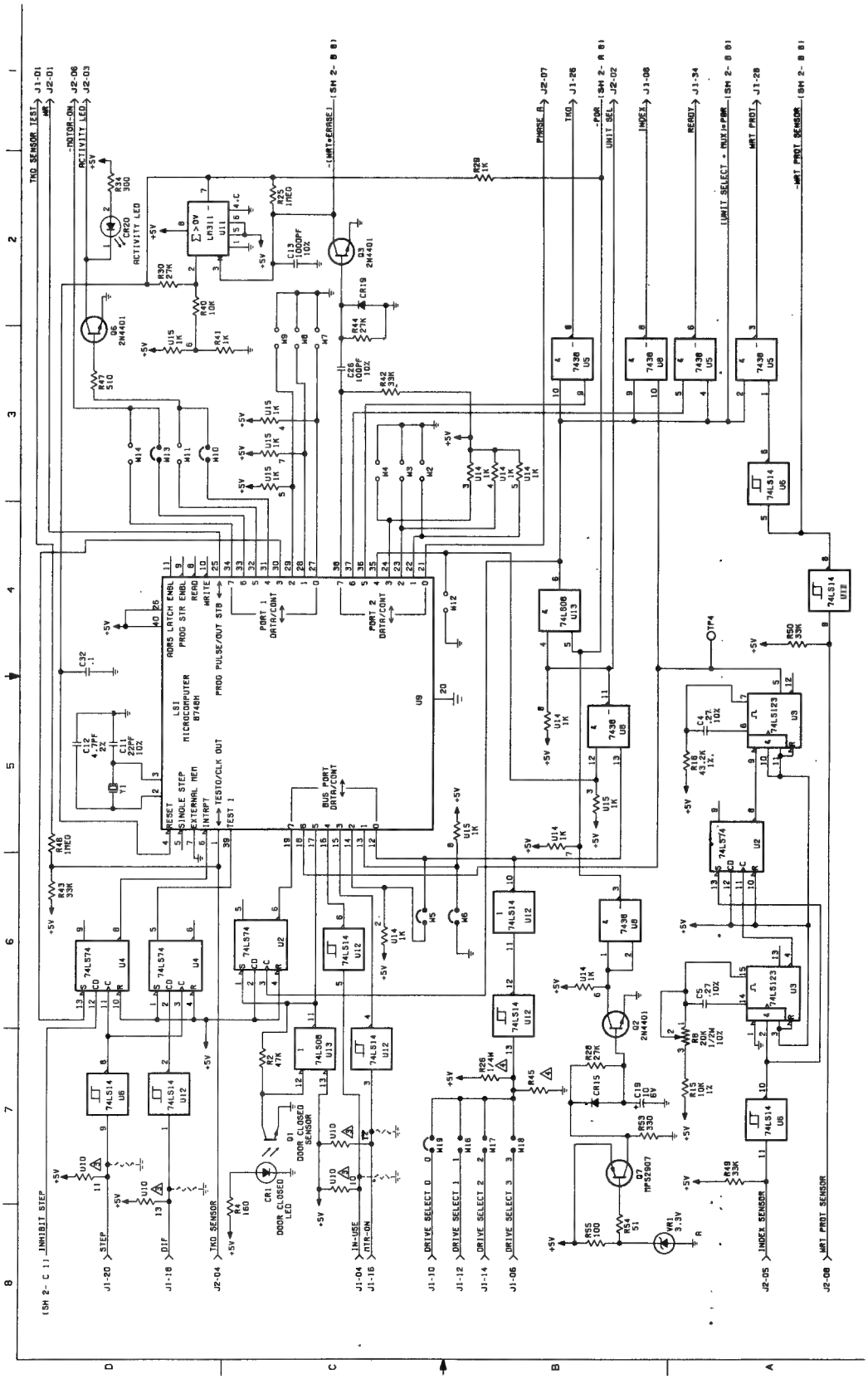
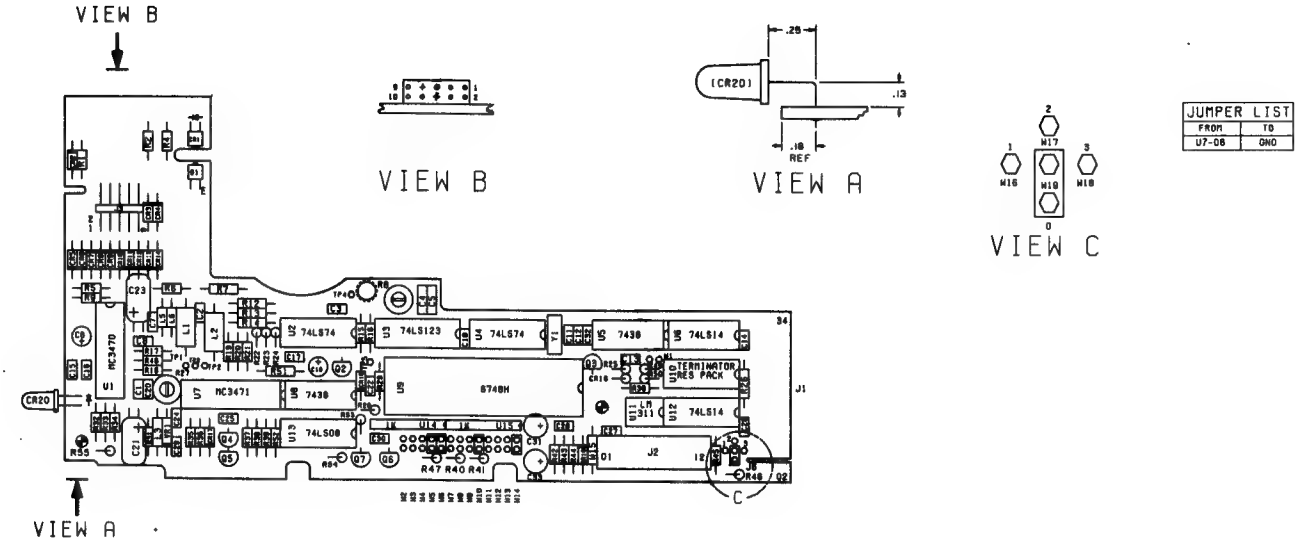
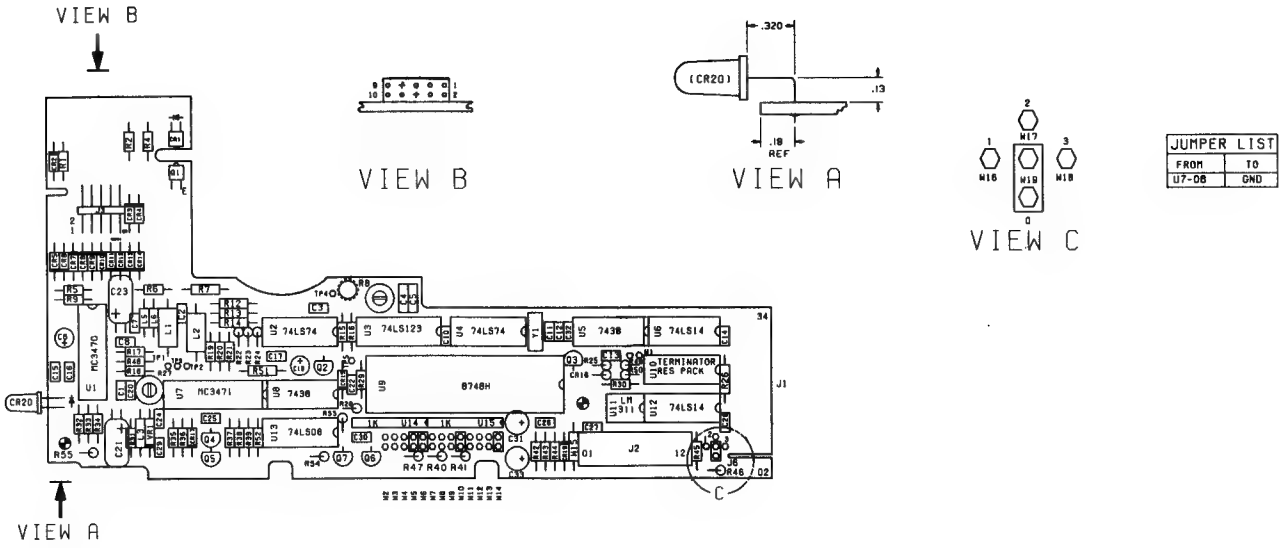


FIGURE 5-3D. DATA CONTROL PWA'S 77743720 AND 77743940 (SHEET 3 OF 5)




| | |
|---|---|
| CR1 | = SEP8507-2 |
| CR2 - CR16, CR19 | = IN914B |
| CR17 | = IN4001 |
| CR20 | = LED |
| VR1 | = 3.3V 5% |
| Q1 | = SDP8407-1 |
| Q2, Q3, Q5, Q6 | = 2N4401 |
| Q4, Q7 | = MPS2907 |

FIGURE 5-3D. DATA CONTROL PWA 77743720
(SHEET 4 OF 5)




| | |
|---|---|
| CR1 | = SEP8507-2 |
| CR2 - CR16, CR19 | = IN914B |
| CR17 | = IN4001 |
| CR20 | = LED |
| VR1 | = 3.3V 5% |
| Q1 | = SDP8407-1 |
| Q2, Q3, Q5, Q6 | = 2N4401 |
| Q4, Q7 | = MPS2907 |

FIGURE 5-3D. DATA CONTROL PWA 77743940
(SHEET 5 OF 5)

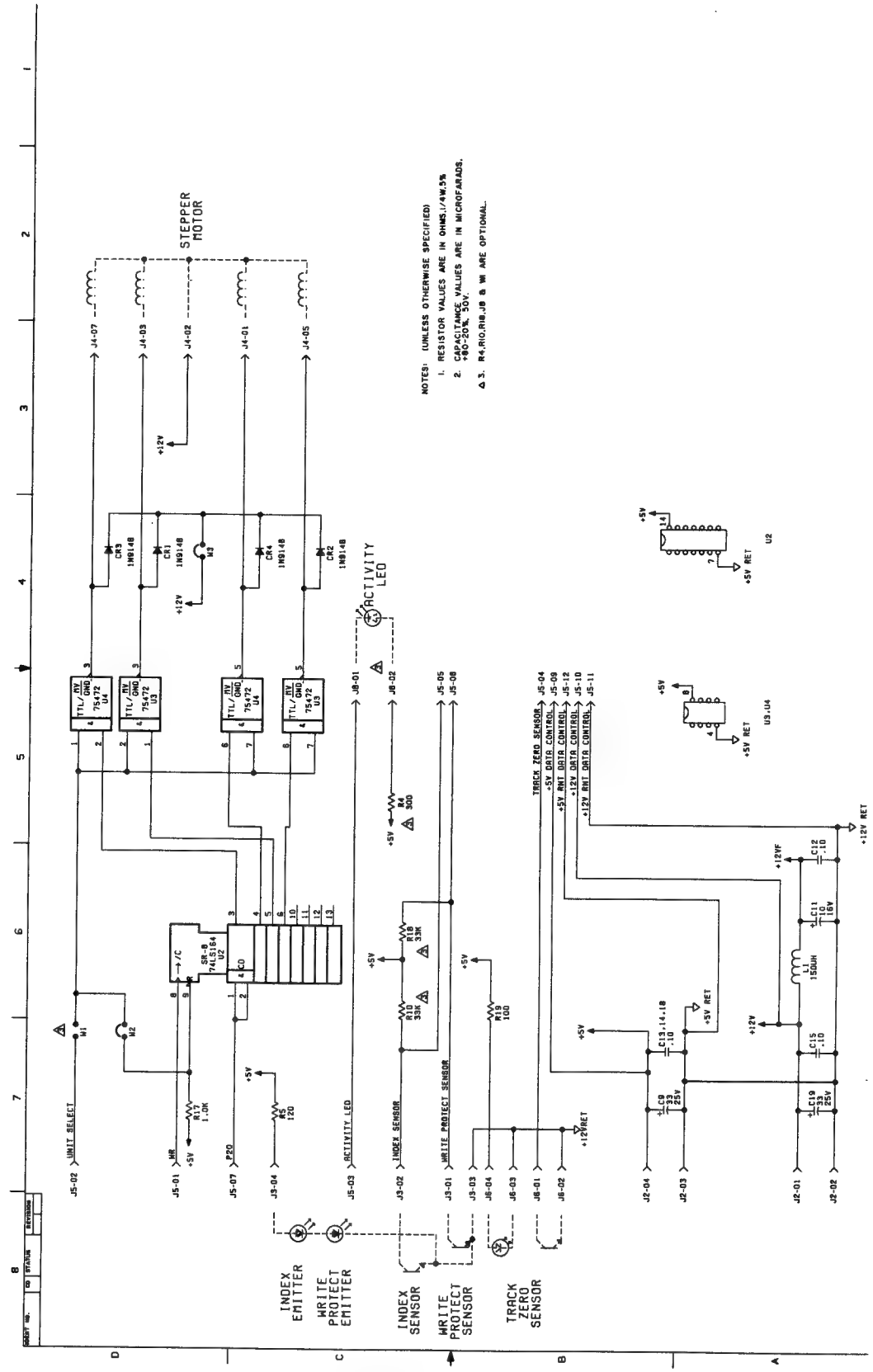



FIGURE 5-4A. MOTOR CONTROL PWA'S 77738651 AND 77740185 (SHEET 1 OF 4)

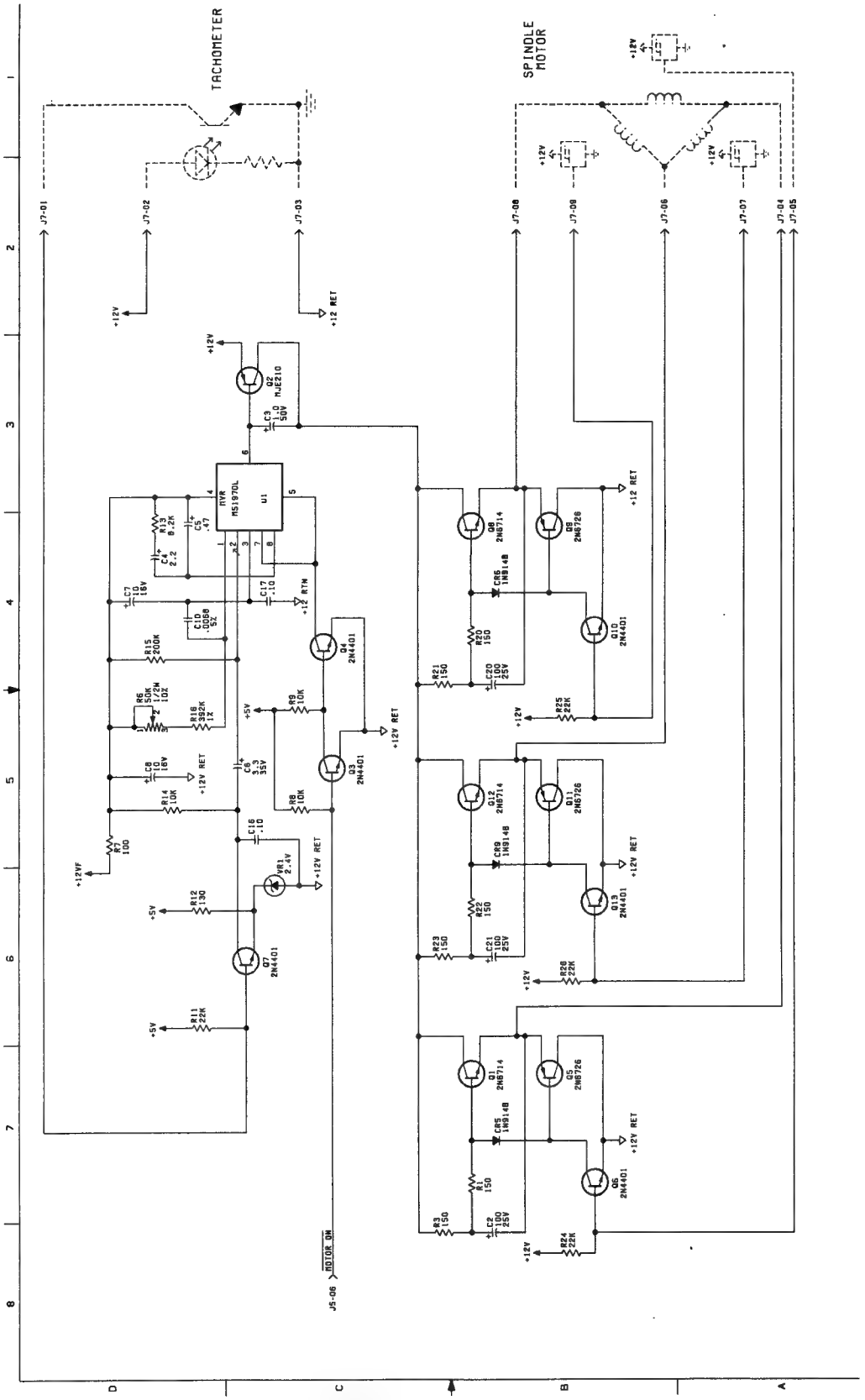
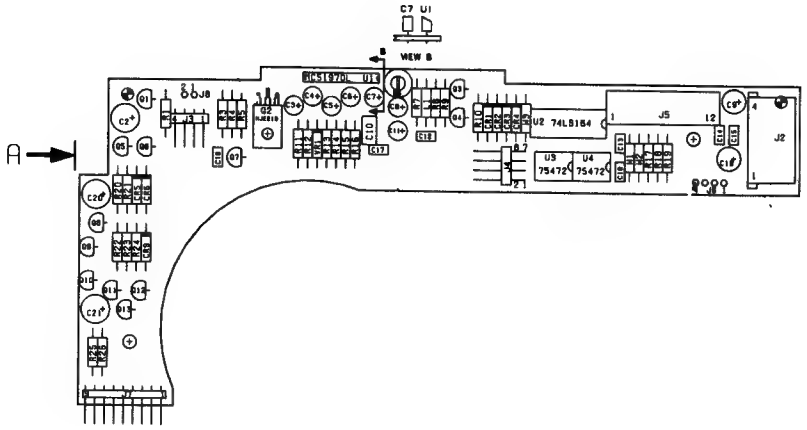
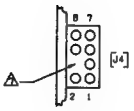



FIGURE 5-4A. MOTOR CONTROL PWA'S 77738651 AND 77740185 (SHEET 2 OF 4)

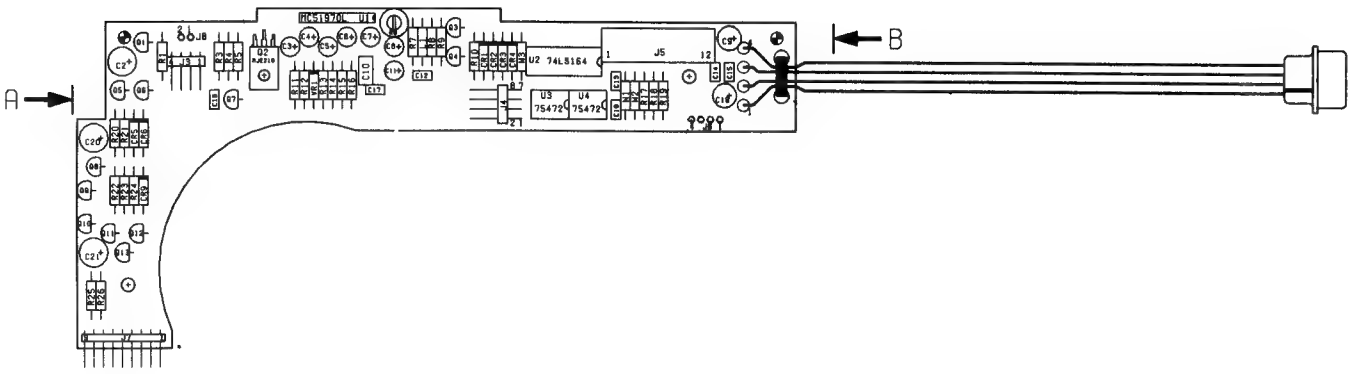



| JUMPER LIST | |
|---|---|
| FROM | TO |
| C19-W | C14-S |
| | |



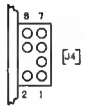

| | |
|---|---|
| CR1 - CR6, CR9 | = 1N914B |
| VR1 | = 2.4V 5% |
| Q1, Q8, Q12 | = 2N6714 |
| Q2 | = MJE210 |
| Q3, Q4, Q6, Q7, Q10, Q13 | = 2N4401 |
| Q5, Q9, Q11 | = 2N6726 |

FIGURE 5-4A. MOTOR CONTROL PWA 77738651
(SHEET 3 OF 4)





VIEW B




VIEW A

| | |
|---|---|
| CR1 - CR6, CR9 | = 1N914B |
| VR1 | = 2.4V 5% |
| Q1, Q8, Q12 | = 2N6714 |
| Q2 | = MJE210 |
| Q3, Q4, Q6, Q7, Q10, Q13 | = 2N4401 |
| Q5, Q9, Q11 | = 2N6726 |

FIGURE 5-4A. MOTOR CONTROL PWA 77740185
(SHEET 4 OF 4)

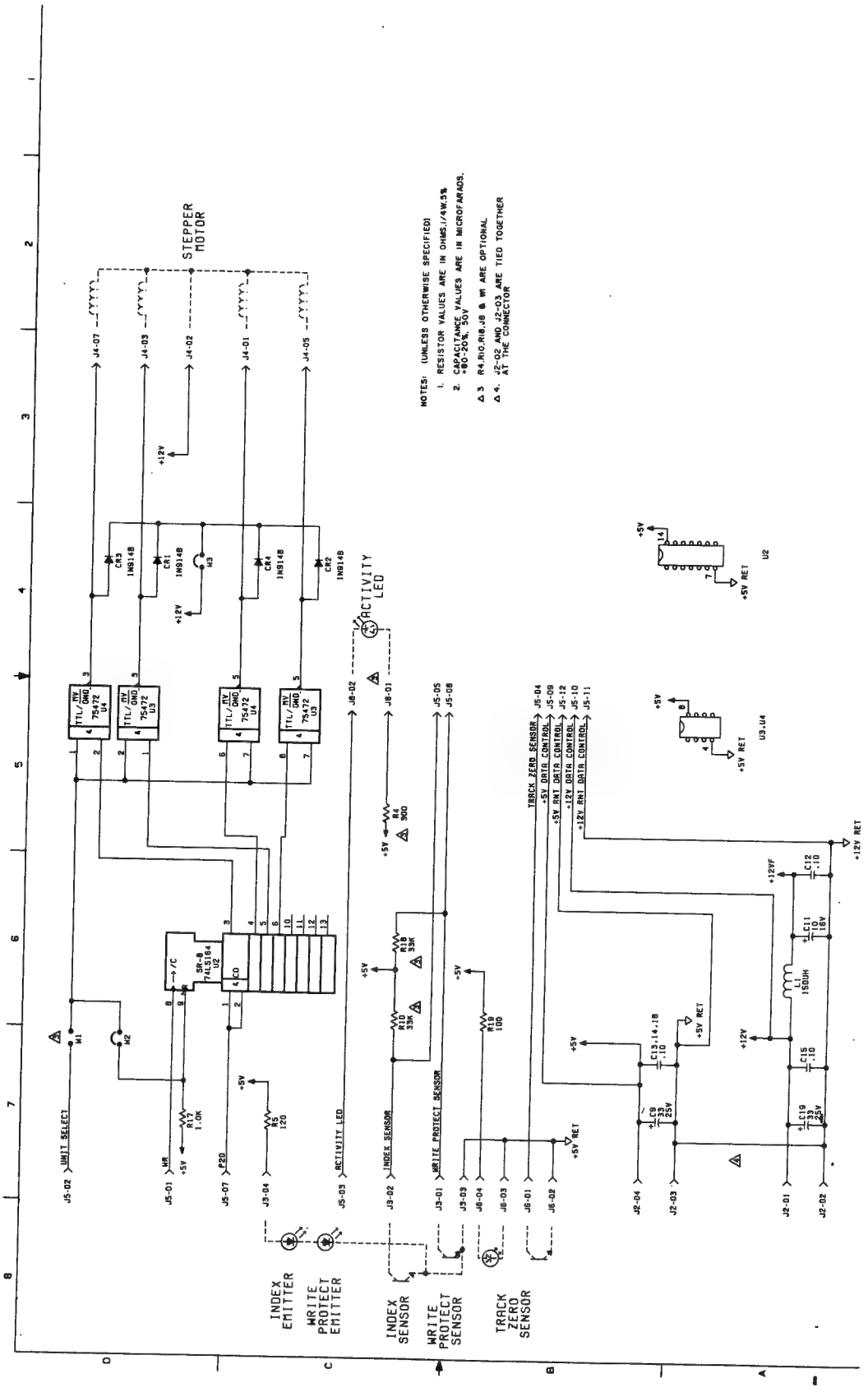



FIGURE 5-4B. MOTOR CONTROL PWA'S 77741571, 77743670 AND 77743785 (SHEET 1 OF 4)

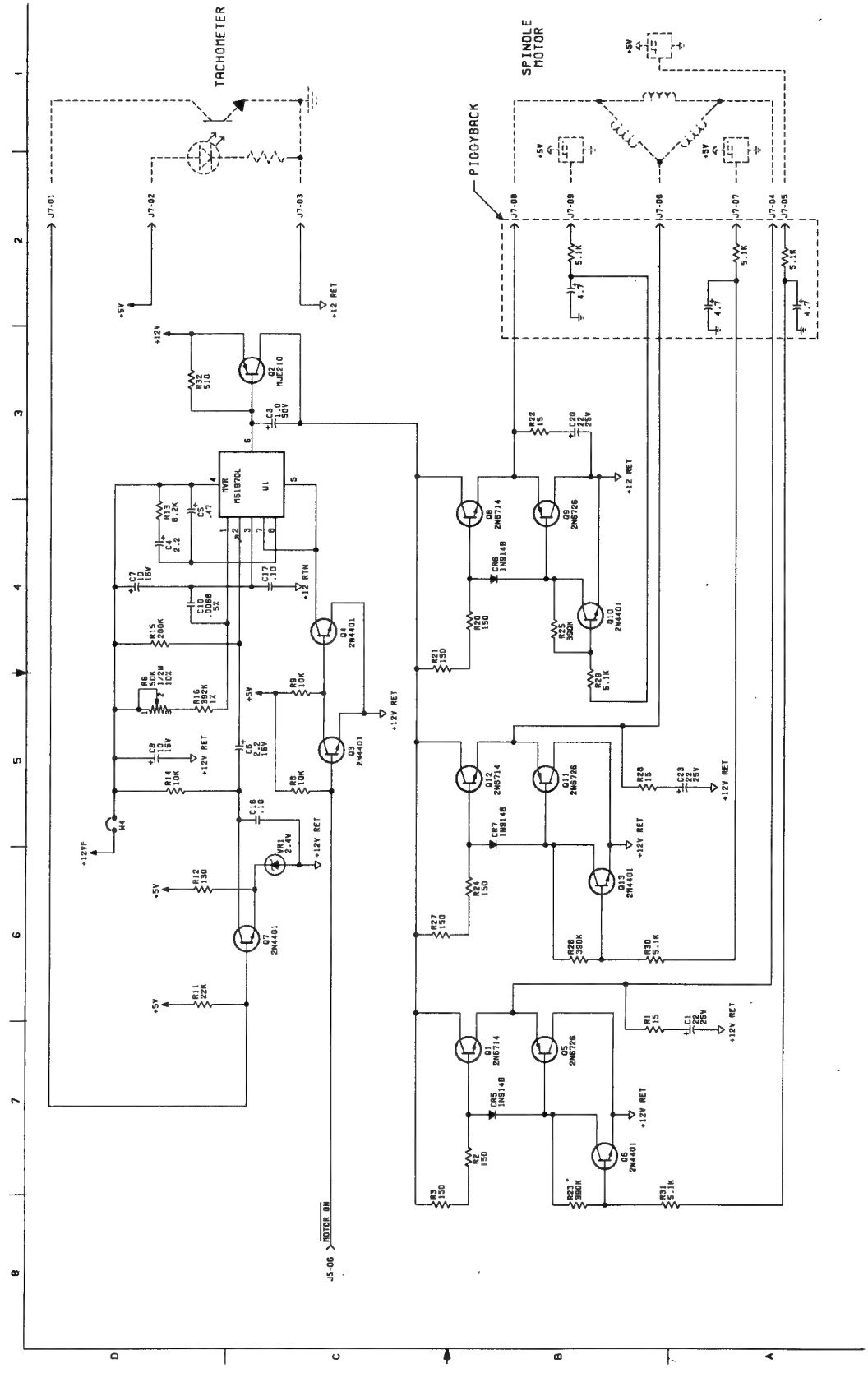
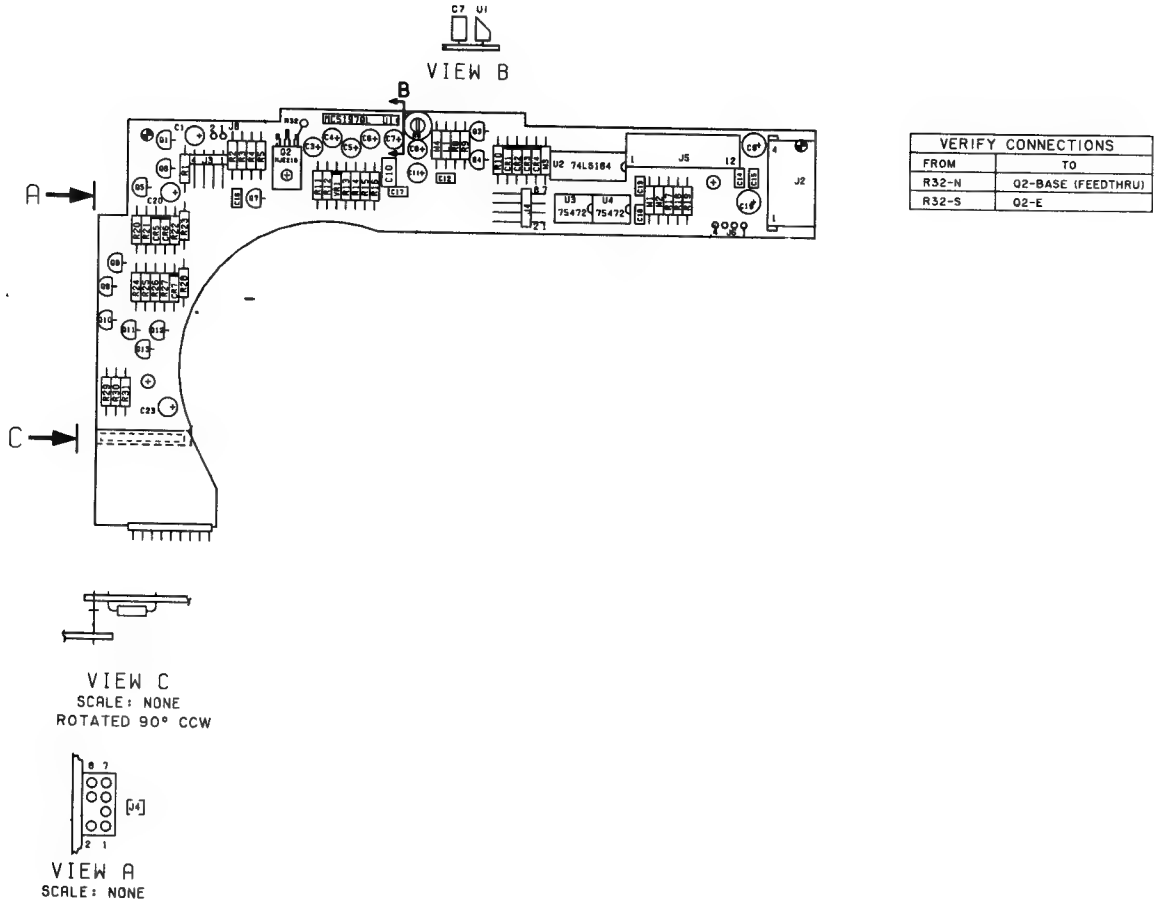
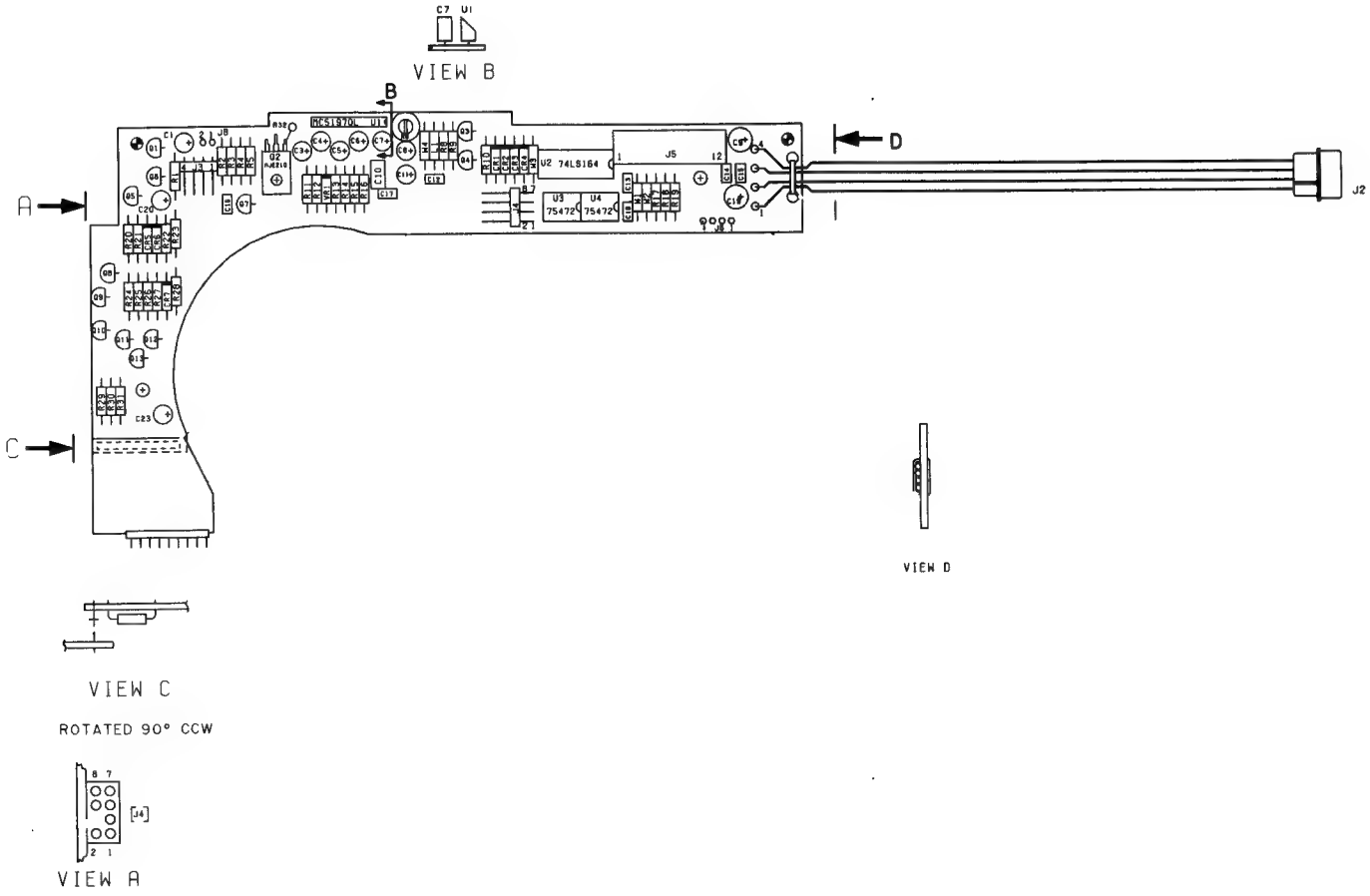



FIGURE 5-4B. MOTOR CONTROL PWA's 77741571, 77743670 AND 77743785 (SHEET 2 OF 4)




| | |
|---|---|
| CR1 - CR7 | = 1N914B |
| VR1 | = 2.4 5% |
| Q1, Q8, Q12 | = 2N6714 |
| Q2 | = MJE210 |
| Q3, Q4, Q6, Q7, Q10, Q13 | = 2N4401 |
| Q5, Q9, Q11 | = 2N6726 |

FIGURE 5-4B. MOTOR CONTROL PWA 77741571
(SHEET 3 OF 4)




| | |
|---|---|
| CR1 - CR7 | = 1N914B |
| VR1 | = 2.4 5% |
| Q1, Q8, Q12 | = 2N6714 |
| Q2 | = MJE210 |
| Q3, Q4, Q6, Q7, Q10, Q13 | = 2N4401 |
| Q5, Q9, Q11 | = 2N6726 |

FIGURE 5-4B. MOTOR CONTROL PWA'S 77743670 AND 77743785
(SHEET 4 OF 4)

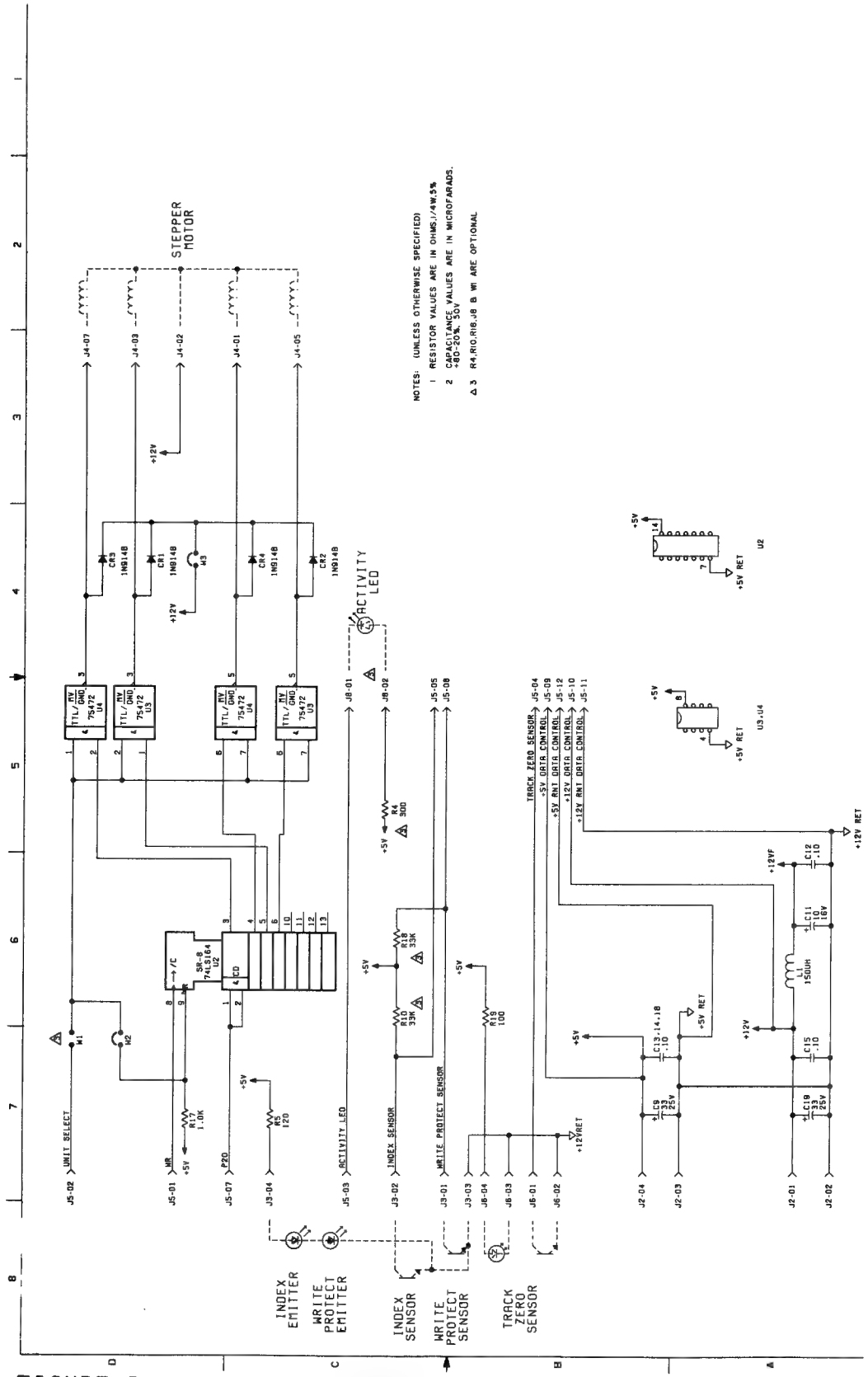



FIGURE 5-4C. MOTOR CONTROL PWA'S 77743656 AND 77743661 (SHEET 1 OF 4)

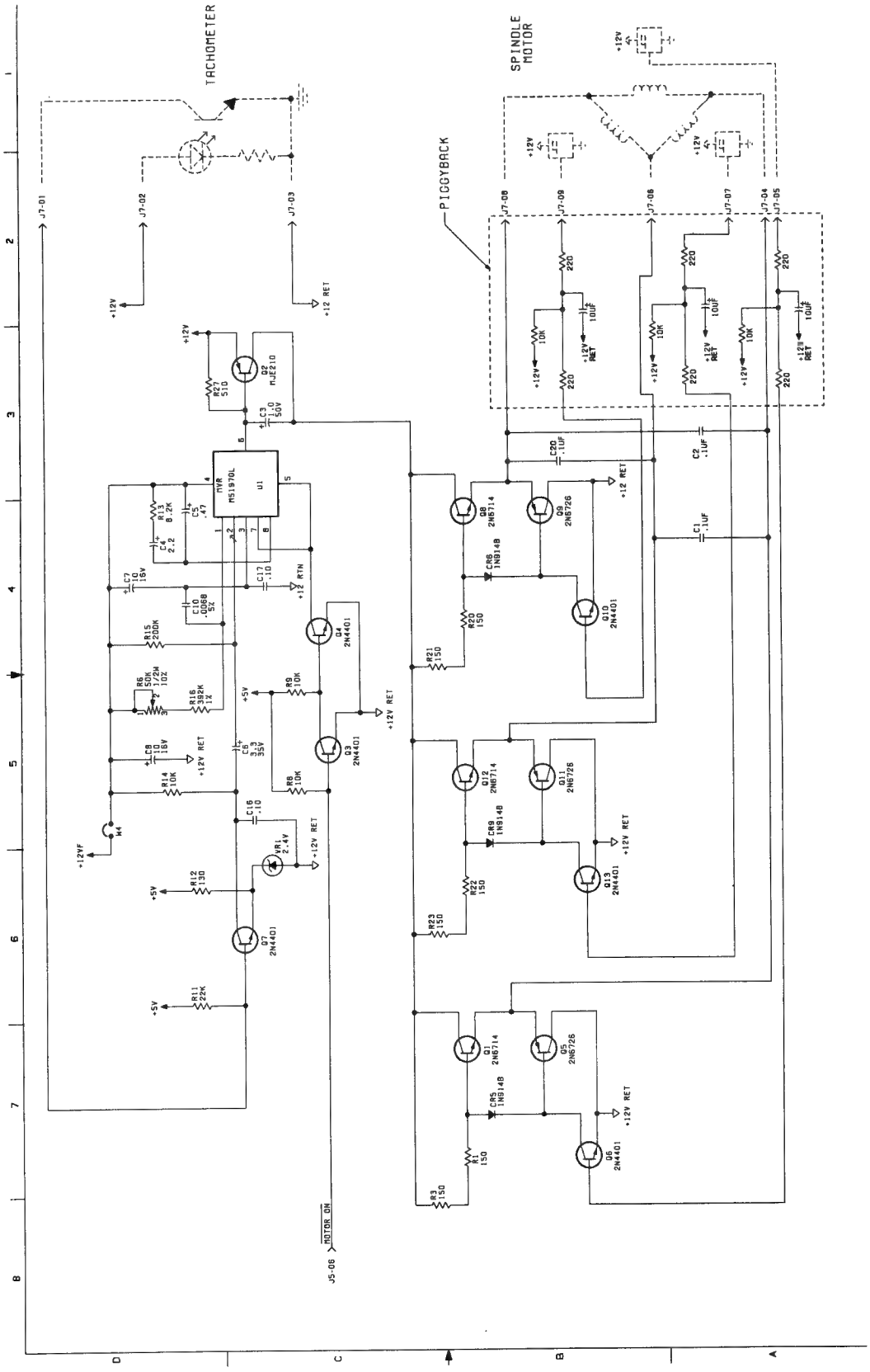
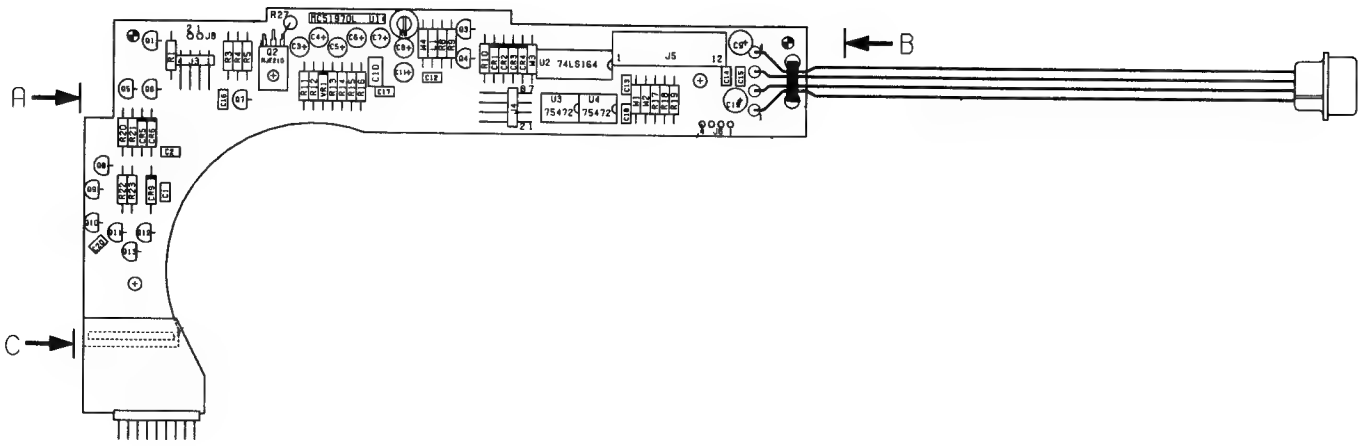
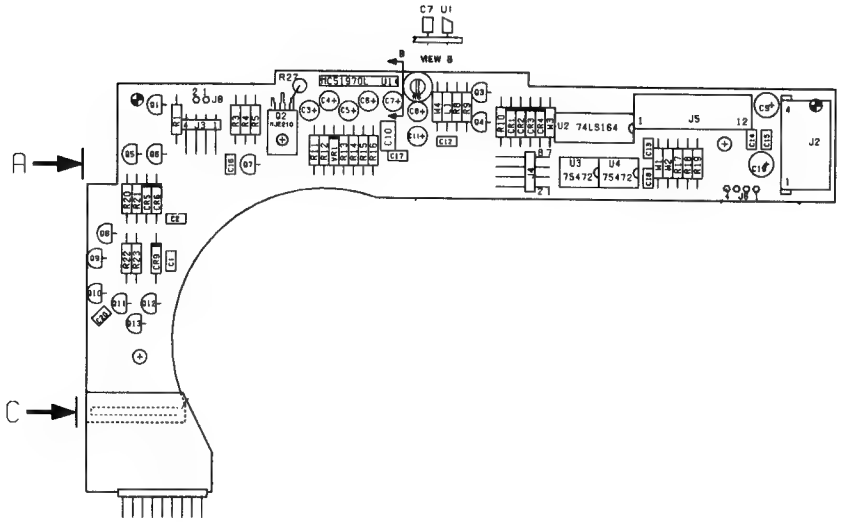



FIGURE 5-4C. MOTOR CONTROL PWA'S 77743656 AND 77743661 (SHEET 2 OF 4)



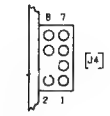

| | |
|---|---|
| CR1 - CR6, CR9 | = 1N914B |
| VR1 | = 2.4V 5% |
| Q1, Q8, Q12 | = 2N6714 |
| Q2 | = MJE210 |
| Q3, Q4, Q6, Q7, Q10, Q13 | = 2N4401 |
| Q5, Q9, Q11 | = 2N6726 |

FIGURE 5-4C. MOTOR CONTROL PWA 77743656
(SHEET 3 OF 4)

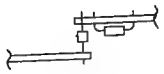



| JUMPER LIST | |
|---|---|
| FROM | TO |
| C19-W | C14-S |
| | |

| VERIFY CONNECTIONS | |
|---|---|
| FROM | TO |
| R27-N | Q2-BASE |
| R27-S | Q2-E |
| C1-N | Q1-EMIT |
| C1-S | Q12-EMIT |
| C2-W | Q8-EMIT |
| C2-E | Q1-EMIT |
| C20-N | Q8-EMIT |
| C20-S | Q12-EMIT |




VIEW A



VIEW C

| | |
|---|---|
| CR1 - CR6, CR9 | = 1N914B |
| VR1 | = 2.4V 5% |
| Q1, Q8, Q12 | = 2N6714 |
| Q2 | = MJE210 |
| Q3, Q4, Q6, Q7, Q10, Q13 | = 2N4401 |
| Q5, Q9, Q11 | = 2N6726 |

FIGURE 5-4B. MOTOR CONTROL PWA 77743661
(SHEET 4 OF 4)

## 6.1 INTRODUCTION

This section contains the instructions required to maintain the FDD.

## 6.2 MAINTENANCE TOOLS

Special tools (or equivalent) required to maintain an FDD are:

| DESCRIPTION | PART NUMBER |
|---|---|
| Alignment Diskette | DYSAN 224/2A or 208-22 |

Standard tools required to maintain the FDD are:

- Screwdrivers
  Sizes: Phillips #1, Phillips #2
- Allen Wrenches
  Sizes: 0.050 inch (1.27 mm), 7/64 inch (2.78 mm)
- Oscilloscope, Tektronix 335, or equivalent.

## 6.3 TROUBLESHOOTING

An improperly adjusted FDD may exhibit symptoms of one that has a malfunction; therefore, the Adjustment Procedures (Section 6.4) should be performed before assuming the unit has failed. Refer to Figure 5-3 to locate test points to be used in troubleshooting. Before troubleshooting is started, check all DC supply voltages.

### 6.3.1 DC VOLTAGE AND SIGNAL

a. Input power should be +5 V $\pm$5% and +12 V $\pm$10% measured at the input to the FDD (refer to Section 3.4).

b. The signals should conform to the diagrams and waveforms shown in Figures 5-1, 6-1, 6-2 and 6-3.

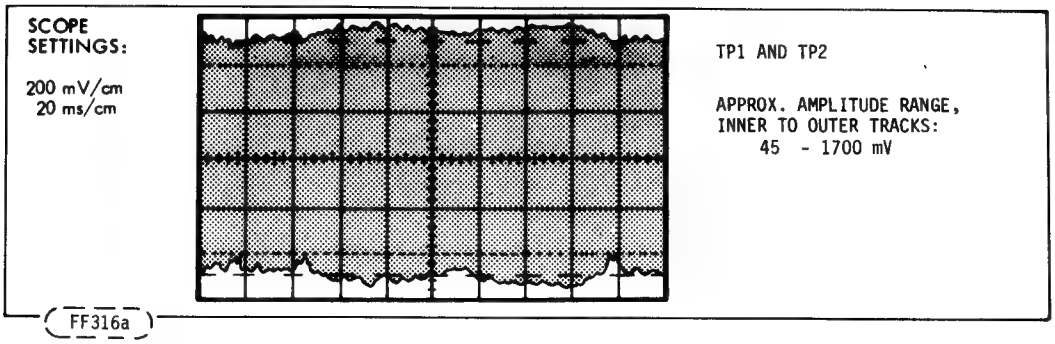



FIGURE 6-1. DIFFERENTIAL READ SIGNAL FOR ENTIRE TRACK

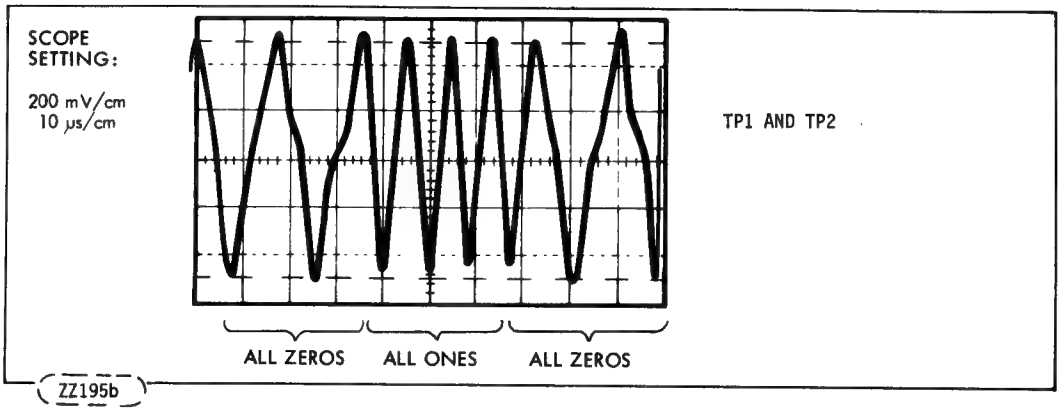



FIGURE 6-2. DIFFERENTIAL READ SIGNAL FOR PORTION OF OUTER TRACK

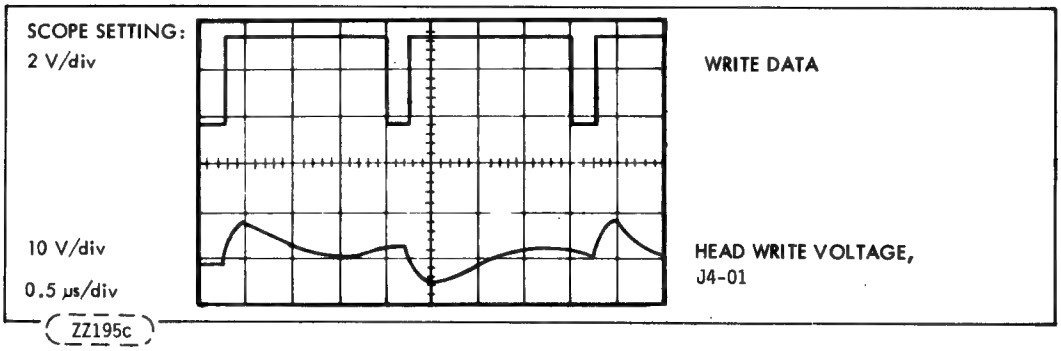



FIGURE 6-3. WRITE DATA AND HEAD WRITE VOLTAGE FOR OUTER TRACK

## 6.4 ADJUSTMENT PROCEDURES

### 6.4.1 INDEX TO BURST CHECK AND ADJUSTMENT

The Alignment Diskette is used to perform this procedure. Spindle speed must be correct before performing this adjustment. Refer to Section 6.4.4 and perform spindle speed adjustment if necessary.

a. Precondition the Alignment Diskette (DYSAN 224/2A or 208-22) by allowing it one hour to reach room temperature.
b. Alignments should not be attempted if the FDD and alignment media are not stabilized within the environmental limits of 65°-75° F (18.3°-23.8° C) and 40%-60% relative humidity.

**CAUTION**

> The Alignment Diskette is for read only. Extreme caution should be used to be sure this diskette is not written on.

c. Install the alignment diskette. Seek to Track 00, then seek to Track 34 and Read. (No data is recorded on Track 34.)
d. Connect Channel 1 of scope to TP1 on the PWA. Channel 2 to J1-08 of the PWA. Set up the scope as follows:

| | |
|---|---|
| Channel 1 Scale: | 0.1 Volts/Div |
| Channel 2 Scale: | 2 Volts/Div |
| Channel 1 Coupling: | AC |
| Channel 2 Coupling: | AC |
| Vertical Mode: | ADD |
| Trigger Mode: | Normal |
| Trigger Source: | Channel 1 |
| Trigger Coupling: | Low Frequency (High Frequency Reject) |
| Trigger Slope: | Negative |
| Time Base: | 50 µs/Div |

e. To check a drive's index to burst time when the index optics or PWA have not been loosened, adjusted, or replaced:

   Verify the time from the leading edge of the Index pulse to the burst pulse measures 200 +200 -150 µs. If time is 200 +200 -150 µs, it is acceptable and proceed to Step "g". (Refer to Figure 6-4B.)

   If the index optics or PWA have been loosened, adjusted or replaced it is not sufficient to check index to burst timing. The index to burst adjustment procedure must be performed: proceed to Step "f".

f. Adjust the time from the leading edge of the Index pulse to the midpoint between the burst pulses of Head 0 and Head 1 at Track 34 until it measures 200 ±20 us, (refer to Figure 6-4a). To adjust the index to burst time turn index potentiometer on the Data Control PWA.

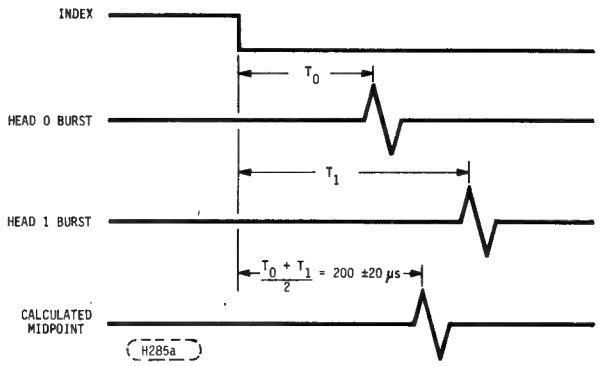



FIGURE 6-4A. INDEX TO BURST TIMING ADJUSTMENT

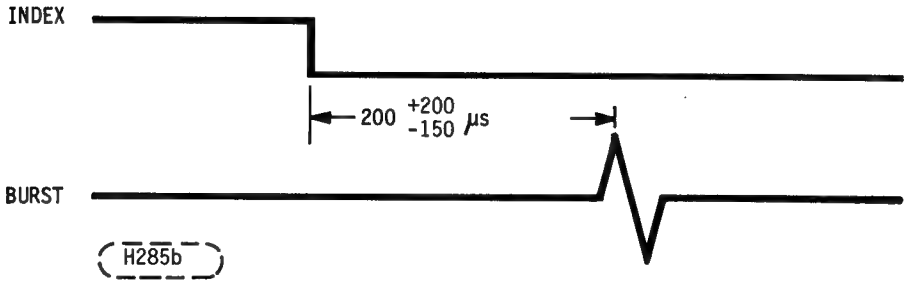



FIGURE 6-4B. INDEX TO BURST TIMING VERIFICATION

g. All scope settings are to remain as defined in the original setup in Step "e", but it may be necessary to adjust the sync. Seek to Track 00 then seek to Track 01 and perform a read. While observing the signal on the scope, remove and reinsert the diskette three times.

Verify that the difference between the minimum and maximum index to burst time measured after each insertion is less than 100 us. In addition, each measurement must meet the index to burst check limits of 200 ±200 -150 us. If the change is greater than 100 us, the cone and spindle must be replaced and Steps "a" through "g" must be repeated.

## 6.4.2 ACTUATOR ALIGNMENT (DISKETTE)

The Alignment Diskette is used to perform this procedure.

a. Precondition Alignment Diskette DYSAN 224/2A or 208-22 by allowing it one hour to reach room temperature.
b. Adjustments should be be attempted if the FDD and alignment media are not stabilized within the environmental limits of 65°-75°F (18.3°-23.8°C) and 40%-60% relative humidity.

CAUTION

The Alignment Diskette is for read only. Extreme caution should be used to be sure this diskette is not written on.

c. Seek to Track 16, select Head 0 and perform a read. (No data is recorded on Track 16. The tester or system requirements should be noted: refer to tester or system instructions for operation.)
d. Connect Channel 1 of scope to TP1 on the PWA and Channel 2 to TP2 on the PWA.
e. Connect the external sync probe to Index, J1-08.
f. Set up scope as follows:

| | |
|---|---|
| Channel 1 Scale: | 0.1 Volts/Div |
| Channel 2 Scale: | 0.1 Volts/Div - Inverted |
| Channel 1 Coupling: | AC |
| Channel 2 Coupling: | AC |
| Vertical Mode: | ADD |
| Trigger Mode: | Normal |
| Trigger Source: | External |
| Trigger Coupling: | Low Frequency (High Frequency Reject) |
| Trigger Slope: | Negative |
| Time Base: | 20 ms/Div |

NOTE

Scope trace, after trigger level is adjusted for repetitive trace should display an envelope of data "cateyes" consisting of two lobes (refer to Figure 6-5). If lobe pattern is observed, proceed to Step "g". If no such pattern can be displayed, proceed to Step "h".

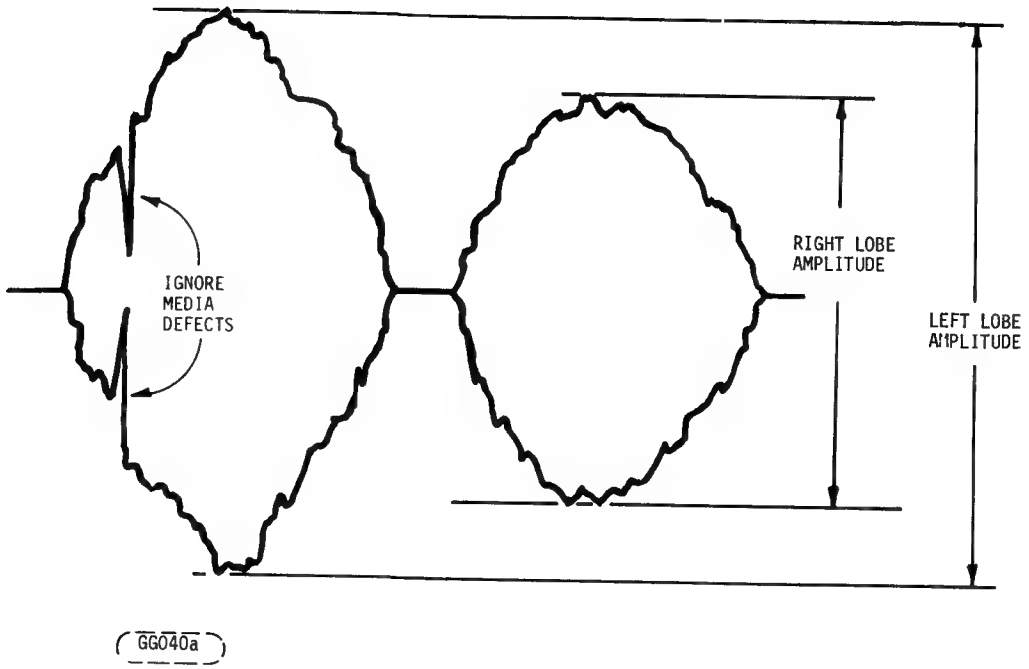



FIGURE 6-5. HEAD ALIGNMENT AMPLITUDE

g. To check a drive's alignment when the stepper, band, or carriage has not been loosened, adjusted, or replaced: Verify the voltage ratio of the smaller lobe to the larger lobe is > 70%. If > 70%, alignment is acceptable and check is concluded. If < 70%, proceed to Step "h".

h. Change the scale of Channel 1 and Channel 2 to 0.02 volts/div. Move the trace on the scope (Position Knob) up until the bottom of the two lobes are setting approximately on the base line (refer to Figure 6-5). Loosen the stepper motor mounting screws (see Figure 6-8) and slowly rotate the stepper motor until the amplitude of both lobes is the same.

i. Switch to Head 1 and repeat the measurement of the "cateye" pattern. Adjust the stepper to balance any offset that occurs between the two heads.

j. Tighten the stepper motor screws. Return to Track 00 then seek Track 16. Verify the specification in Step "g" is still met. If the specification is not met, readjust the stepper motor, return to zero, and seek Track 16. Repeat the adjustment until the specification is met.

k. Remove the Alignment Diskette.

l. Perform the Track 00 Switch Adjustment, Section 6.4.3.

## 6.4.3 TRACK '00' SWITCH ADJUSTMENT

Perform the procedure given below whenever the optical Track 00 switch has been replaced, the device fails to give correct Track 00 indication, or the head has been realigned.

a. Perform an alternate seek between Track 00 and Track 02. The "STEP IN" portion of the alternate seek cycle must be symmetrical with the "STEP OUT" portion, including any turn around delays at Track 00 and Track 02. The time between step pulses must be 5 ms with a minimum of 20ms and a maximum of 25 ms when reversing (see Figure 6-6). The Track 00 switch signal on J2-04 (Data PWA) should alternate between high and low logic levels at a 50% duty cycle measured at the +1.2 V level.
b. To adjust, using an Allen wrench, turn the screw (Figure 6-7) that slides the switch bracket to achieve the correct duty cycle.
c. After the Switch has been adjusted, step to Track 00 and verify J2-04 of the Data (upper) PWA is greater than +2 V. Verify J2-04 is less than +0.5 V when stopped on Track 02, approached from each direction.
d. Using the Alignment Diskette, verify the Track 00 signal is present at TP1 and TP2 when the carriage is restored to Track 00.

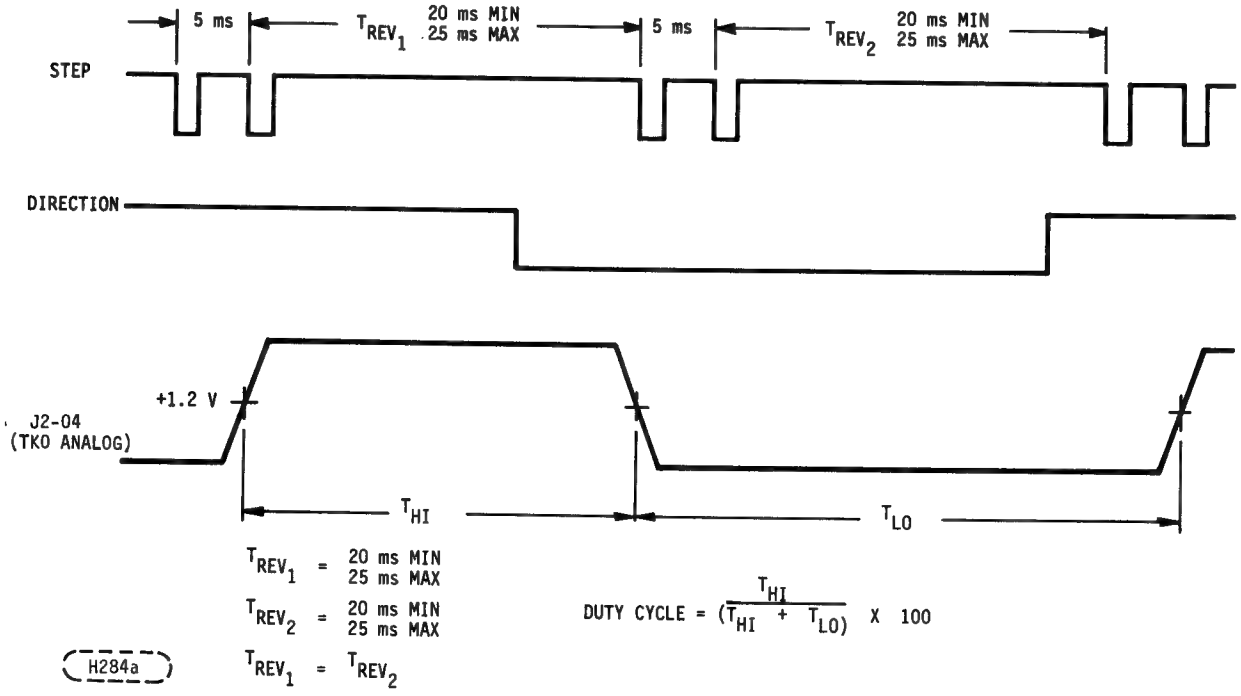



FIGURE 6-6. STEP PULSE TIMING DIAGRAM

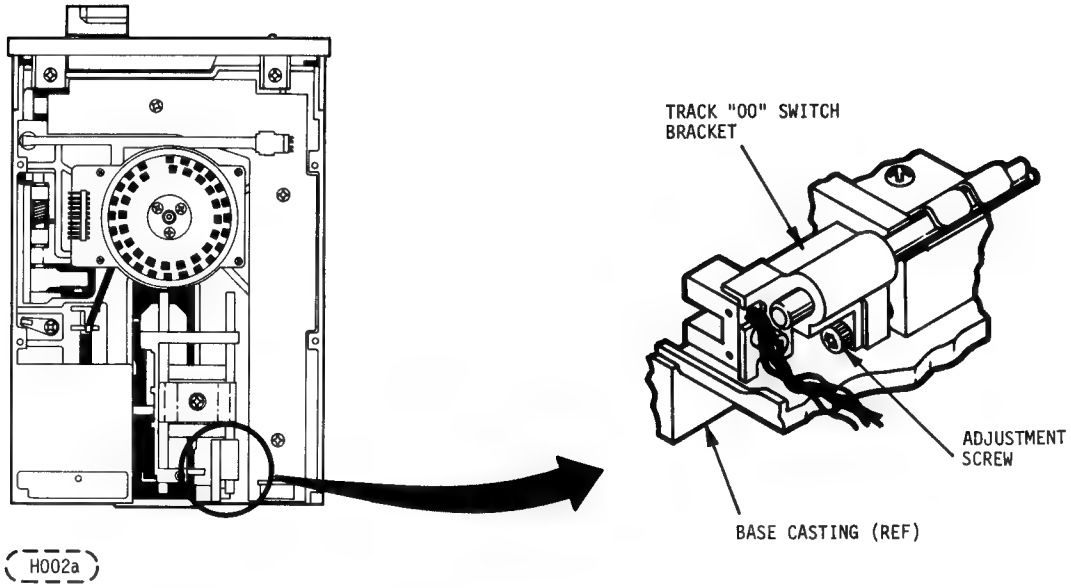



FIGURE 6-7. TRACK '00' ADJUSTMENT

## 6.4.4 SPINDLE SPEED ADJUSTMENT

Adjust the potentiometer on the motor control PWA to set the spindle speed to 300 ±3 r/min. Adjust for a stable spindle strobe disk pattern for the appropriate frequency (50 or 60 Hz) or adjust for 200 ±2 ms between the leading edges of the index pulses. For this adjustment a diskette must be installed.

## 6.5 REMOVAL AND REPLACEMENT PROCEDURES

The following procedures are arranged in the proper sequence for removal and replacement of major assemblies. To avoid damage to parts, the procedures must be performed in sequence.

Replacement of the stepper motor assembly and head assembly require special tools and procedures and should not be attempted except by factory trained personnel.

### 6.5.1 PRINTED WIRE ASSEMBLIES (PWAs)

a. Disconnect the I/O Cable from J1 and DC power from J2 (refer to Figure 3-1).
b. Disconnect the harness and head connectors from the PWAs.
c. Remove the retaining screws from the PWAs.
d. Remove the PWAs by lifting them from their original positions.
e. To replace the PWAs, reconnect the harness and head connectors.
f. When reinstalling screws in the motor control PWA, tighten the screw through Q2 first.
g. Program the option shunts if necessary and reconnect the I/O cable, and DC power.
h. Perform the spindle speed adjustment (Section 6.4.4).
i. Perform the index to burst adjustment (Section 6.4.1.).

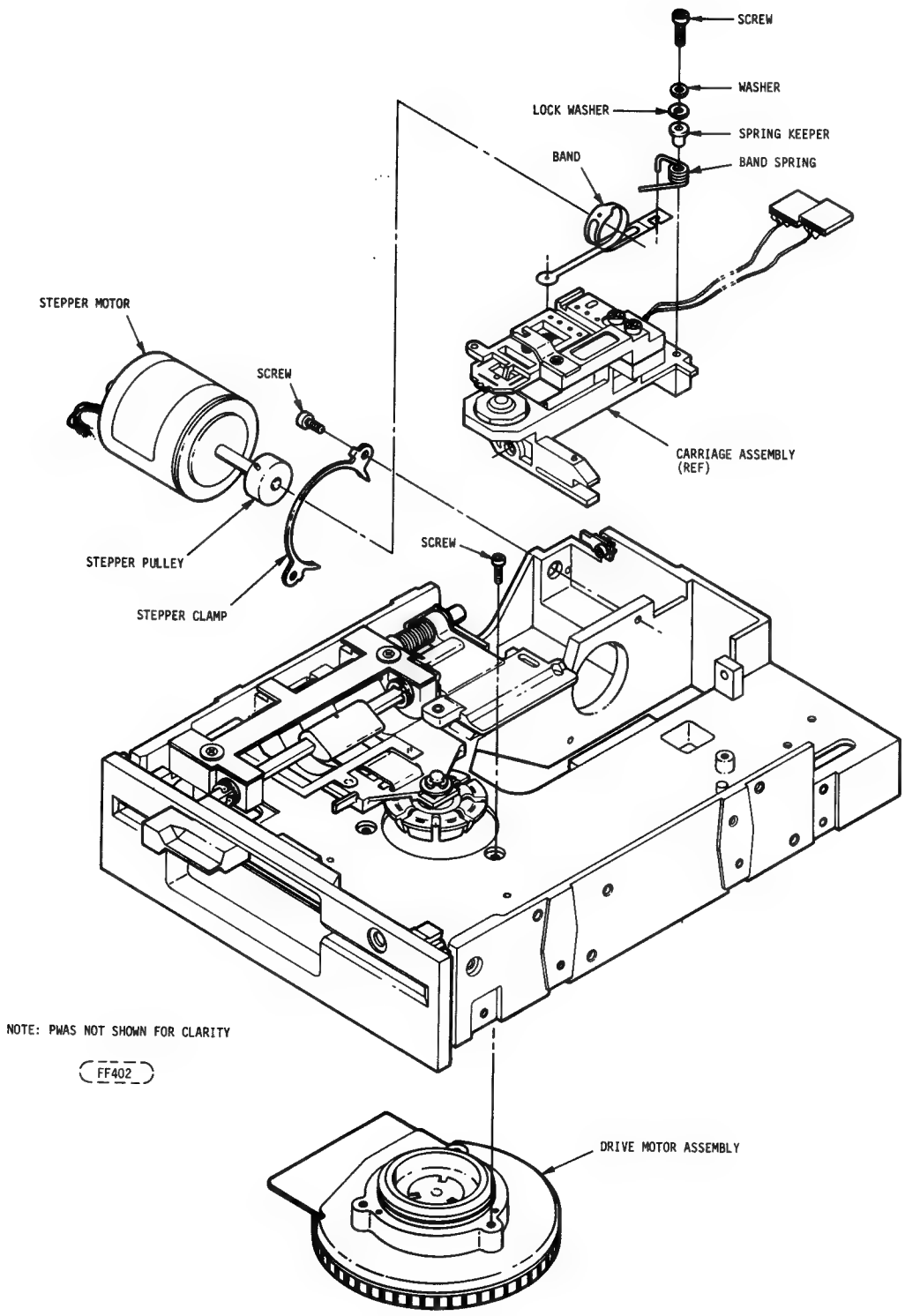



FIGURE 6-8. DRIVE MOTOR REMOVAL

## 6.5.2 SPINDLE MOTOR ASSEMBLY

a. Perform the removal procedure for the Data (upper) PWA (Section 6.5.1).
b. Remove three (3) screws securing the spindle motor (Figure 6-8).
c. Disconnect the motor harness and remove the spindle motor assembly.
d. To install the spindle motor assembly in the drive, reassemble the components of the removal operations (Steps "a" through "c") in reverse order.
e. If a new spindle motor assembly is installed, perform the Spindle Speed Adjustment (Section 6.4.4).

THIS SECTION HAS
BEEN DELETED

## 8.1 INTRODUCTION

This section contains an illustrated parts breakdown that describes and illustrates the Model 9428/29 Flexible Disk Drive (FDD).

## 8.2 ILLUSTRATIONS

Item numbers within a circle (1) indicate an assembly (group of parts). Item numbers without a circle, 1, indicate a single part of a group of parts which is normally replaced as an assembly.

## 8.3 PARTS LIST

In addition to the accompanying parts list of each illustration, two additional Parts Lists are available; the Numerical Parts List and the Cross Reference Index. Instruction for the use of all Parts Lists is given in paragraph 8.6.

## 8.4 REPLACEMENT PARTS

When ordering replacement parts for the FDD, the inclusion of the following information for each part ordered will ensure positive identification:

1. Publication Number at the bottom of this page.
2. Figure and Item Number
3. Product Identification Number (HPC) and Description

**NOTE**

Before ordering parts however, refer to paragraph 8.5 Spare Parts.

## 8.5 SPARE PARTS

This Illustrated Parts Breakdown is complete to the extent that all parts and assemblies are depicted and identified. Replacement part availability depends on the materials and provisioning operation of the supplier.

## 8.6 PARTS LIST INSTRUCTIONS

### 8.6.1 ILLUSTRATION PARTS LISTS

The parts list for each illustration contains only those parts referenced by an item number on the illustration. Refer to paragraph 8.6.2 for explanation of parts list.

### 8.6.2 NUMERICAL PARTS LIST

a. Lists all parts in Item Number sequence.

b. Correlates Item Numbers with part identification numbers and the description of each.

c. Identifies where each part is used (where used column) within the device by listing the Item Number(s) of the next higher assembly.

d. Defines the location of each part by listing the sheet number(s) where depicted.

**NOTE**

The same part may be used in any number of assemblies or sheet locations.

### 8.6.3 CROSS REFERENCE INDEX

- Lists all parts in numeric sequence (by Identification Number), in conjunction with the referenced sheet number (third column).

- Defines the sheet number location of each item identified.

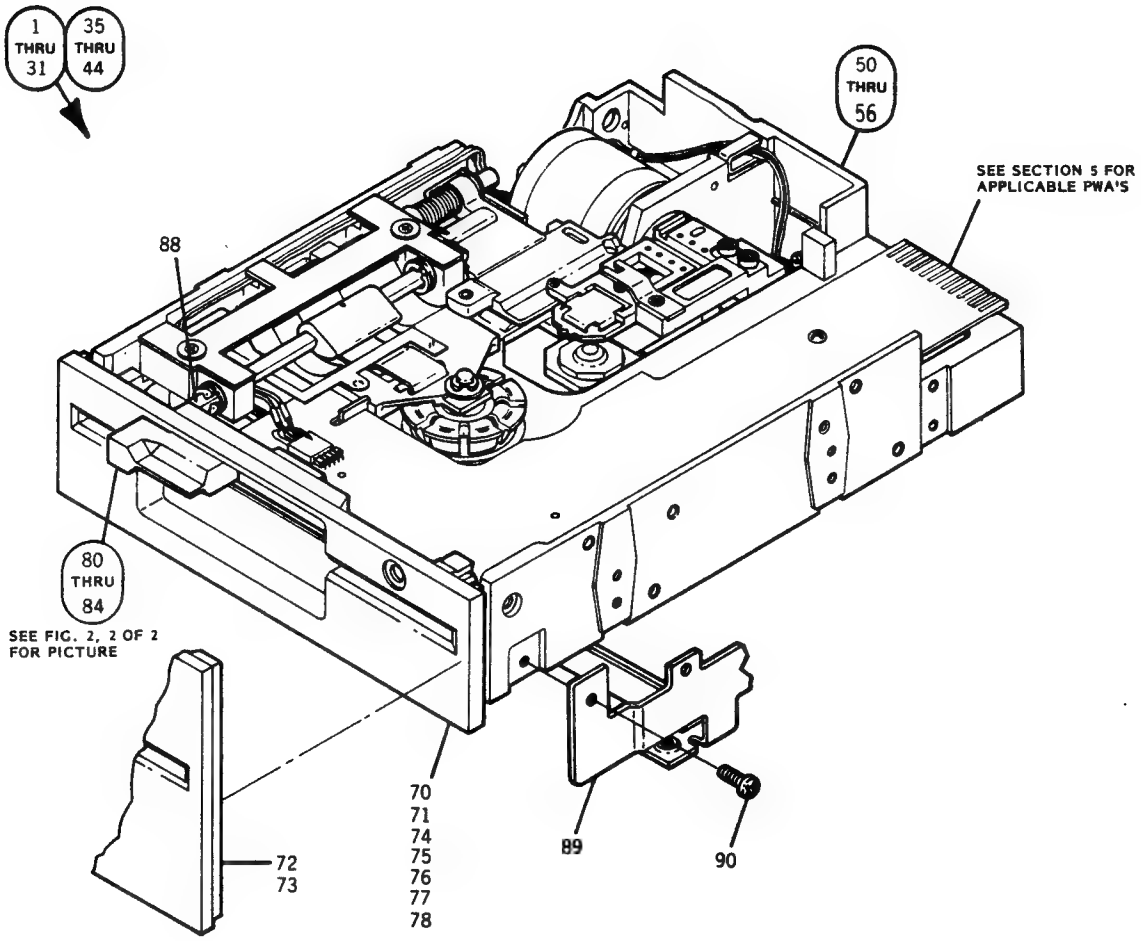
### 8.6.4 SHEET NUMBER REFERENCING

Sheet number references of Parts Lists and Illustrations refers to sheet locations in this section. Example: Sheet reference 3 represents sheet 8-3, sheet 4 represents sheet 8-4, etc.

# WHERE USED MATRIX
## (By Item Number)

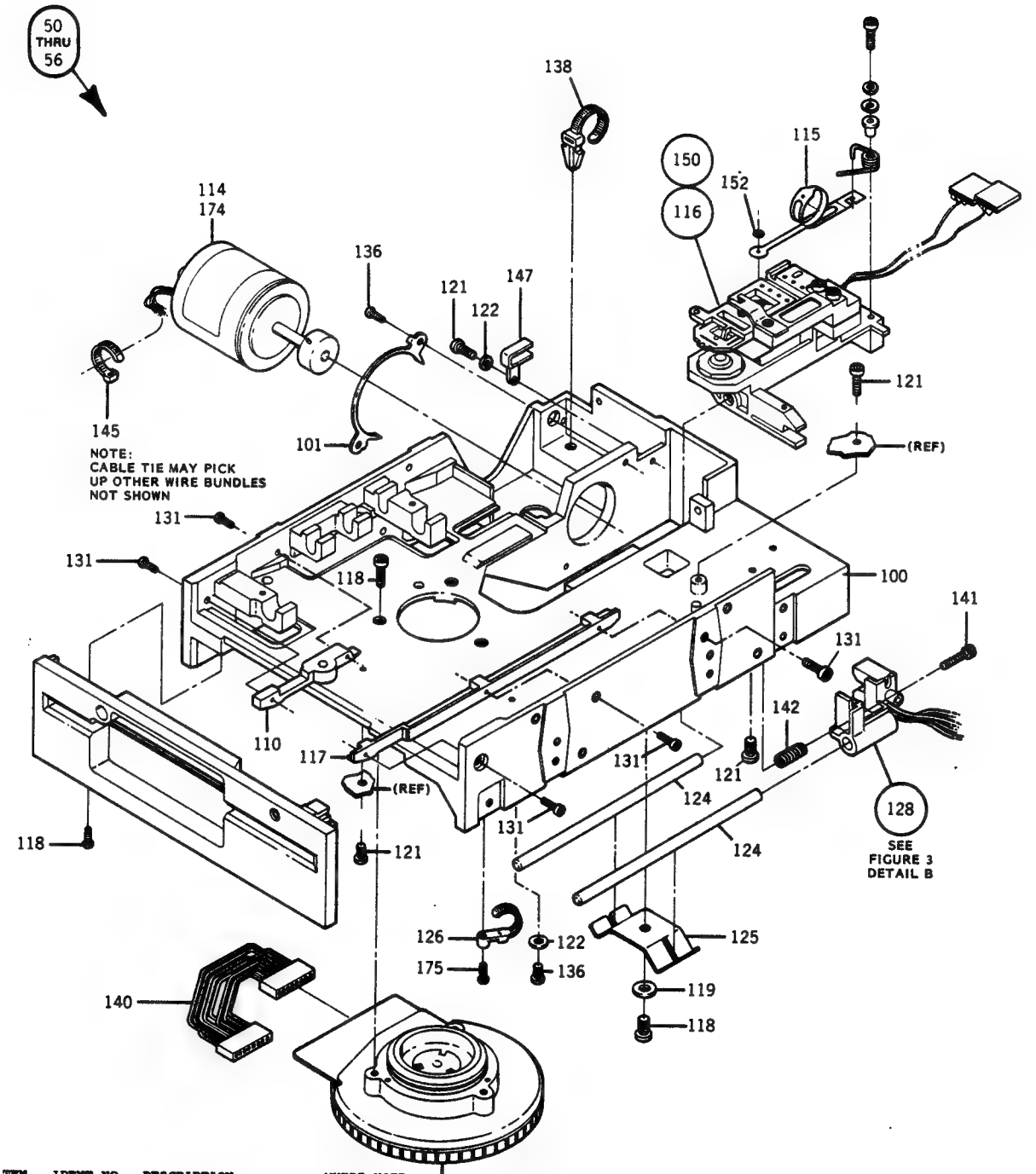
| ITEM | | HPC | ITEM | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 80 | 81 | 82 | 83 | 84 | 88 | 89 | 90 |
| | 1 | 77740000 | X | | | | | | | X | | | | | | | | | X | | | | | | | |
| | 2 | 77740001 | X | | | | | | | | | X | | | | | | | X | | | | | | | |
| | 3 | 77740002 | | | | | | | X | X | | | | | | | | | X | | | | | | | |
| | 4 | 77740003 | X | | | | | | | X | | | | | | | | | X | | | | | | | |
| | 5 | 77740004 | X | | | | | | | | | X | | | | | | | X | | | | | | X | X |
| | 6 | 77740005 | X | | | | | | | X | | | | | | | | | X | | | | | | | |
| | 7 | 77740006 | X | | | | | | | | | | X | | | | | | | | X | | | X | | |
| | 8 | 77740007 | X | | | | | | | | | | | | | X | | | | | X | | | X | | |
| | 9 | 77740008 | | | | | X | | | | | | X | | | | | | | | X | | | X | | |
| | 10 | 77740009 | | | | | X | | | | | | | | | | X | | | | X | | | X | | |
| | 11 | 77740010 | | | | | X | | | X | | | | | | | | | X | | | | | | | |
| | 12 | 77740011 | | X | | | | | | X | | | | | | | | | X | | | | | | | |
| | 13 | 77740012 | | X | | | | | | X | | | | | | | | | X | | | | | | | |
| 9 | 14 | 77740013 | | X | | | | | | | | X | | | | | | | X | | | | | | | |
| 4 | 15 | 77740014 | | | | | | X | | | | | | | | | | X | | | | X | | X | | |
| 2 | 16 | 77740015 | | X | | | | | | | | X | | | | | | | X | | | | | | | |
| 8 | 17 | 77740016 | | | | | X | | | | | X | | | | | | | X | | | | | | | |
| | 18 | 77740017 | | | | | X | | | X | | | | | | | | | X | | | | | | | |
| | 19 | 77740018 | | | | | X | | | | | X | | | | | | | X | | | | | | | |
| | 20 | 77740054 | | | | X | | | | X | | | | | | | | | X | | | | | | | |
| | 21 | 77740055 | | X | | | | | | X | | | | | | | | | X | | | | | | | |
| | 22 | 77740056 | | | | X | | | | X | | | | | | | | | X | | | | | | | |
| | 23 | 77740057 | | | | X | | | | | | X | | | | | | | X | | | | | | | |
| | 24 | 77740058 | | | | X | | | | X | | | | | | | | | X | | | | | | | |
| | 25 | 77740059 | | | | X | | | | | | X | | | | | | | X | | | | | | | |
| | 26 | 77740060 | | | | X | | | | X | | | | | | | | | X | | | | | | | |
| | 27 | 77740061 | | | | | X | | | X | | | | | | | | | X | | | | | | | |
| | 28 | 77740062 | | | | | X | | | | | | | | X | | | | | | X | | | X | | |
| | 29 | 77740076 | | | | X | | | | X | | | | | | | | | X | | | | | | | |
| | 30 | 77740077 | | | | X | | | | | | X | | | | | | | X | | | | | | | |
| | 31 | 77740078 | | | | X | | | | X | | | | | | | | | X | | | | | | | |

| ITEM | | HPC | ITEM | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 80 | 81 | 82 | 83 | 84 | 88 | 89 | 90 |
| | 35 | 77743000 | | | X | | | | | X | | | | | | | | | X | | | | | | | |
| | 36 | 77743001 | | | X | | | | | | | X | | | | | | | X | | | | | | | |
| | 37 | 77743002 | | | X | | | | | X | | | | | | | | | X | | | | | | | |
| 9 | 38 | 77743003 | | | X | | | | | X | | | | | | | | | X | | | | | | | |
| 4 | 39 | 77743004 | | | X | | | | | | X | | | | | | | | | X | | | | | | |
| 2 | 40 | 77743005 | | | X | | | | | | X | | | | | | | | | X | | | | | | |
| 9 | 41 | 77743006 | | | X | | | | | X | | | | | | | | | X | | | | | | | |
| | 42 | 77743007 | | | X | | | | | | | | | X | | | | | | | | | X | | | |
| | 43 | 77743008 | | | X | | | | | | | | | X | | | | | | | | | X | | | |
| | 44 | 77743009 | | | X | | | | | | X | | | | | | | | | X | | | | | | |




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 1 | 77740000 | HPC | * |
| 2 | 77740001 | HPC | * |
| 3 | 77740002 | HPC | * |
| 4 | 77740003 | HPC | * |
| 5 | 77740004 | HPC | * |
| 6 | 77740005 | HPC | * |
| 7 | 77740006 | HPC | * |
| 8 | 77740007 | HPC | * |
| 9 | 77740008 | HPC | * |
| 10 | 77740009 | HPC | * |
| 11 | 77740010 | HPC | * |
| 12 | 77740011 | HPC | * |
| 13 | 77740012 | HPC | * |
| 14 | 77740013 | HPC | * |
| 15 | 77740014 | HPC | * |
| 16 | 77740015 | HPC | * |
| 17 | 77740016 | HPC | * |
| 18 | 77740017 | HPC | * |
| 19 | 77740018 | HPC | * |
| 20 | 77740054 | HPC | * |
| 21 | 77740055 | HPC | * |
| 22 | 77740056 | HPC | * |
| 23 | 77740057 | HPC | * |
| 24 | 77740058 | HPC | * |
| 25 | 77740059 | HPC | * |
| 26 | 77740060 | HPC | * |
| 27 | 77740061 | HPC | * |
| 28 | 77740062 | HPC | * |
| 29 | 77740076 | HPC | * |
| 30 | 77740077 | HPC | * |
| 31 | 77740078 | HPC | * |
| 35 | 77743000 | HPC | * |
| 36 | 77743001 | HPC | * |
| 37 | 77743002 | HPC | * |
| 38 | 77743003 | HPC | * |
| 39 | 77743004 | HPC | * |
| 40 | 77743005 | HPC | * |
| 41 | 77743006 | HPC | * |
| 42 | 77743007 | HPC | * |
| 43 | 77743008 | HPC | * |
| 44 | 77743009 | HPC | * |
| 50 | 77690502 | TOP MECH ASM | * |
| 51 | 77690504 | TOP MECH ASM | * |
| 52 | 77690505 | TOP MECH ASM | * |
| 53 | 77690506 | TOP MECH ASM | * |
| 54 | 77690508 | TOP MECH ASM | * |
| 55 | 77690509 | TOP MECH ASM | * |
| 56 | 77734091 | TOP MECH ASM | * |
| 70 | 77735001 | FRONT PANEL | * |
| 71 | 77735002 | FRONT PANEL | * |
| 72 | 77739401 | FRONT PANEL | * |
| 73 | 77740901 | FRONT PANEL | * |
| 74 | 77741787 | FRONT PANEL | * |
| 75 | 77741851 | FRONT PANEL | * |
| 76 | 77743101 | FRONT PANEL | * |
| 77 | 77743550 | FRONT PANEL | * |
| 78 | 77743726 | FRONT PANEL | * |
| 80 | 77736901 | CAMSHAFT LEVER ASM | * |
| 81 | 77736902 | CAMSHAFT LEVER ASM | * |
| 82 | 77741275 | CAMSHAFT LEVER ASM | * |
| 83 | 77741276 | CAMSHAFT LEVER ASM | * |
| 84 | 77741762 | CAMSHAFT LEVER ASM | * |
| 88 | 77733896 | MEDIA PUSHER | * |
| 89 | 77734038 | FRAME ASM | * |
| 90 | 67184761 | SCREW | * |

FIGURE 1. HPC

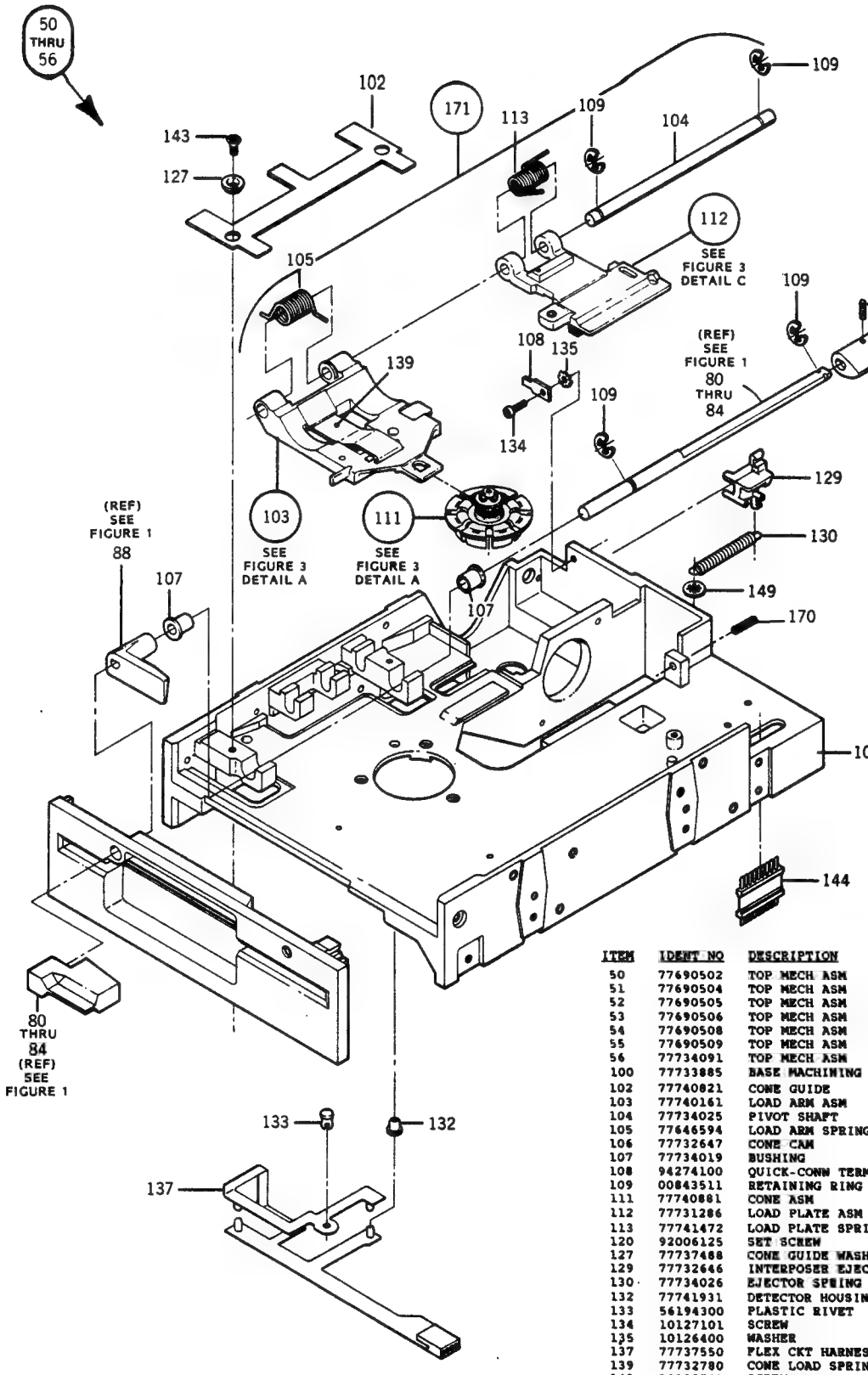



| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 50 | 77690502 | TOP MECH ASM | * |
| 51 | 77690504 | TOP MECH ASM | * |
| 52 | 77690505 | TOP MECH ASM | * |
| 53 | 77690506 | TOP MECH ASM | * |
| 54 | 77690508 | TOP MECH ASM | * |
| 55 | 77690509 | TOP MECH ASM | * |
| 56 | 77734091 | TOP MECH ASM | * |
| 100 | 77733885 | BASE MACHINING | 50-56 |
| 101 | 77732648 | CLAMP | 50-56 |
| 110 | 77734016 | LEFT GUIDERAIL | 50-56 |
| 114 | 77740151 | STEPPER MTR ASM | 52 |
| 115 | 77738817 | BAND ASM | 50-56 |
| 116 | 77741420 | HEAD ASM | 50,51 |
| 116 | 77741420 | HEAD ASM | 53-56 |
| 117 | 77734021 | RIGHT GUIDERAIL | 50-56 |
| 118 | 10127111 | SCREW | 50-56 |
| 119 | 10125605 | WASHER | 50-56 |
| 121 | 10127102 | SCREW | 50-56 |

*SEE WHERE USED MATRIX

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 122 | 10125603 | WASHER | 50-56 |
| 123 | 77671895 | MOTORIZED SPINDLE | 50,51 |
| 123 | 77671895 | MOTORIZED SPINDLE | 53,56 |
| 124 | 77734017 | GUIDE ROD | 50-56 |
| 125 | 77733866 | GUIDE ROD SPRING | 50-56 |
| 126 | 94277421 | CABLE TIE STRAP | 50-56 |
| 128 | 77732773 | TRACK "O" ASM | 50-56 |
| 131 | 95873210 | SCREW | 50-56 |
| 136 | 10127104 | SCREW | 50-56 |
| 138 | 77612011 | CABLE TIE | 50-56 |
| 140 | 77731291 | SPNDL MTR HARNESS | 50-55 |
| 141 | 10126220 | SCREW | 50-56 |
| 142 | 94205369 | SPRING | 50-56 |
| 145 | 94277400 | CABLE TIE STRAP | 50-56 |
| 147 | 77731249 | CABLE GUARD | 50-56 |
| 150 | 77741421 | HEAD ASM | 52 |
| 151 | 77671896 | MOTORIZED SPINDLE | 52,54,55 |
| 152 | 92074152 | O-RING | 50-56 |
| 174 | 77672237 | STEPPER MOTOR | 50,51 |
| 174 | 77672237 | STEPPER MOTOR | 53-56 |
| 175 | 10127113 | SCREW | 50-56 |

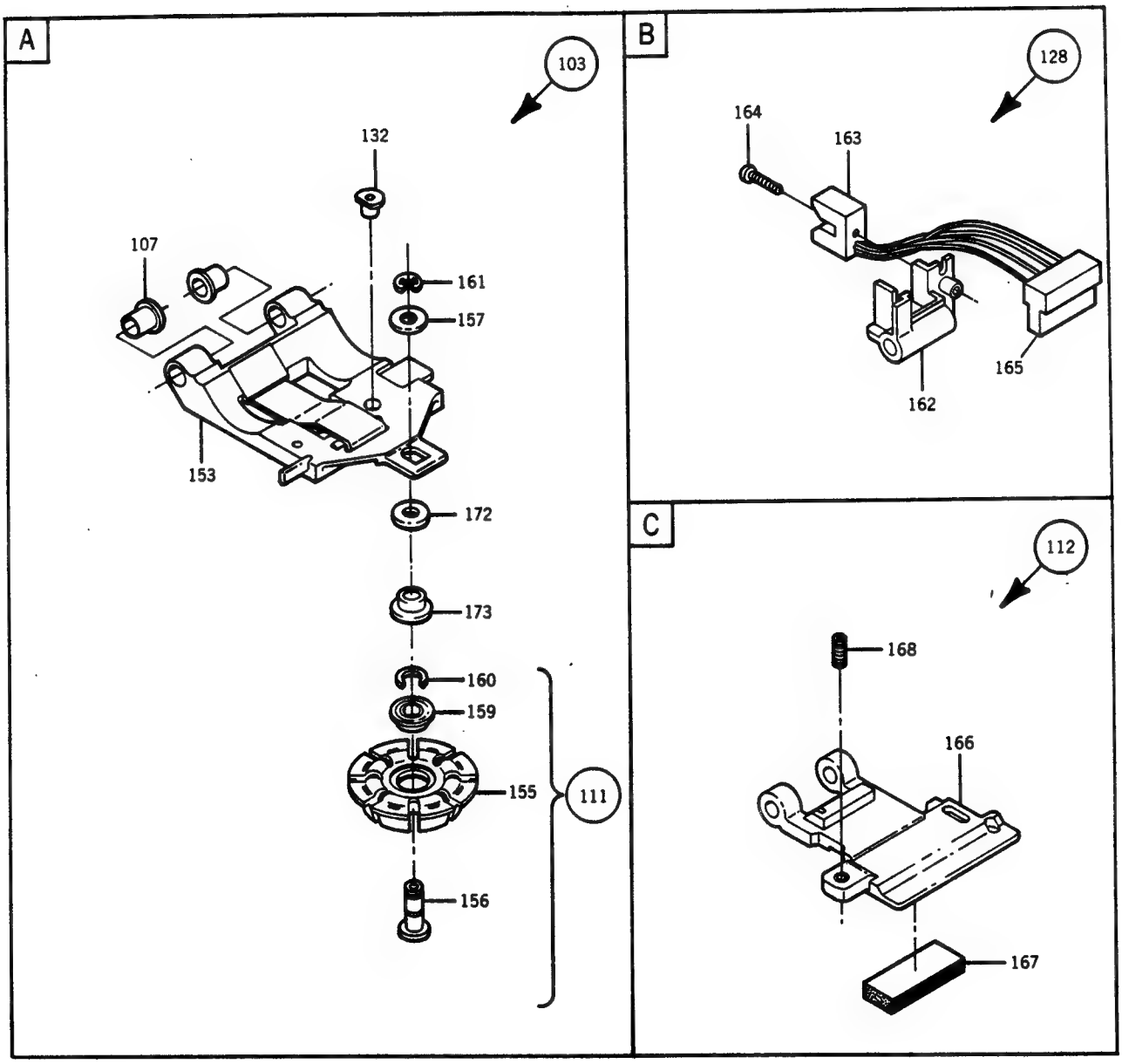
FIGURE 2. TOP MECH ASSEMBLY (1 OF 2)




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 50 | 77690502 | TOP MECH ASM | * |
| 51 | 77690504 | TOP MECH ASM | * |
| 52 | 77690505 | TOP MECH ASM | * |
| 53 | 77690506 | TOP MECH ASM | * |
| 54 | 77690508 | TOP MECH ASM | * |
| 55 | 77690509 | TOP MECH ASM | * |
| 56 | 77734091 | TOP MECH ASM | * |
| 100 | 77733885 | BASE MACHINING | 50-56 |
| 102 | 77740821 | CONE GUIDE | 50-56 |
| 103 | 77740161 | LOAD ARM ASM | 171 |
| 104 | 77734025 | PIVOT SHAFT | 171 |
| 105 | 77646594 | LOAD ARM SPRING | 171 |
| 106 | 77732647 | CONE CAM | 50-56 |
| 107 | 77734019 | BUSHING | 50-56,103 |
| 108 | 94274100 | QUICK-CONN TERMINAL | 50-56 |
| 109 | 00843511 | RETAINING RING | 50-56,171 |
| 111 | 77740881 | CONE ASM | 171 |
| 112 | 77731286 | LOAD PLATE ASM | 171 |
| 113 | 77741472 | LOAD PLATE SPRING | 171 |
| 120 | 92006125 | SET SCREW | 50-56 |
| 127 | 77737488 | CONE GUIDE WASHER | 50-56 |
| 129 | 77732646 | INTERPOSER EJECTOR | 50-56 |
| 130 | 77734026 | EJECTOR SPRING | 50-56 |
| 132 | 77741931 | DETECTOR HOUSING | 50-56,103 |
| 133 | 56194300 | PLASTIC RIVET | 50-56 |
| 134 | 10127101 | SCREW | 50-56 |
| 135 | 10126400 | WASHER | 50-56 |
| 137 | 77737550 | FLEX CKT HARNESS | 50-56 |
| 139 | 77732780 | CONE LOAD SPRING | 171 |
| 143 | 10125703 | SCREW | 50-56 |
| 144 | 75738702 | CONN HEADER | 50-55 |
| 149 | 51720201 | RETAINING RING | 50-56 |
| 170 | 93820166 | SCREW | 55 |
| 171 | 77743327 | PIVOT SHAFT ASM | 50-56 |

*SEE WHERE USED MATRIX

FIGURE 2. TOP MECH ASSEMBLY (2 OF 2)




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 103 | 77740159 | LOAD ARM ASM | 171 |
| 107 | 77734019 | BUSHING | 50-56,103 |
| 111 | 77734028 | CONE ASM | 171 |
| 112 | 77731286 | LOAD PLATE ASM | 171 |
| 128 | 77732773 | TRACK "O" ASM | 50-56 |
| 132 | 77741931 | DETECTOR HOUSING | 50-56,103 |
| 153 | 77732791 | CONE LOAD ARM | 103 |
| 155 | 77734694 | CONE | 111 |
| 156 | 77740637 | CONE SHAFT | 111 |
| 157 | 77732788 | WASHER | 171 |
| 159 | 77613703 | BALL BEARING | 111 |
| 160 | 92033147 | RETAINING RING | 111 |
| 161 | 92033037 | RETAINING RING | 171 |
| 162 | 77731295 | TRACK "O" BRACKET | 128 |
| 163 | 77649008 | OPTICAL SWITCH | 128 |
| 164 | 94375803 | SCREW | 128 |
| 165 | 77613529 | CONNECTOR | 128 |
| 166 | 77730770 | HEAD LOAD PLATE | 112 |
| 167 | 77646144 | FOAM MEDIA CLAMP | 112 |
| 168 | 93820165 | SCREW | 112 |
| 172 | 77741694 | CAP | 171 |
| 173 | 77741692 | STOP | 171 |

FIGURE 3. MISCELLANEOUS SUBASSEMBLIES

# NUMERICAL PARTS LIST
## (By Item Number)

| ITEM | IDENT NO | DESCRIPTION | WHERE USED | SHEET |
|---|---|---|---|---|
| 1 | 77740000 | HPC | * | S4 |
| 2 | 77740001 | HPC | * | S4 |
| 3 | 77740002 | HPC | * | S4 |
| 4 | 77740003 | HPC | * | S4 |
| 5 | 77740004 | HPC | * | S4 |
| 6 | 77740005 | HPC | * | S4 |
| 7 | 77740006 | HPC | * | S4 |
| 8 | 77740007 | HPC | * | S4 |
| 9 | 77740008 | HPC | * | S4 |
| 10 | 77740009 | HPC | * | S4 |
| 11 | 77740010 | HPC | * | S4 |
| 12 | 77740011 | HPC | * | S4 |
| 13 | 77740012 | HPC | * | S4 |
| 14 | 77740013 | HPC | * | S4 |
| 15 | 77740014 | HPC | * | S4 |
| 16 | 77740015 | HPC | * | S4 |
| 17 | 77740016 | HPC | * | S4 |
| 18 | 77740017 | HPC | * | S4 |
| 19 | 77740018 | HPC | * | S4 |
| 20 | 77740054 | HPC | * | S4 |
| 21 | 77740055 | HPC | * | S4 |
| 22 | 77740056 | HPC | * | S4 |
| 23 | 77740057 | HPC | * | S4 |
| 24 | 77740058 | HPC | * | S4 |
| 25 | 77740059 | HPC | * | S4 |
| 26 | 77740060 | HPC | * | S4 |
| 27 | 77740061 | HPC | * | S4 |
| 28 | 77740062 | HPC | * | S4 |
| 29 | 77740076 | HPC | * | S4 |
| 30 | 77740077 | HPC | * | S4 |
| 31 | 77740078 | HPC | * | S4 |
| 35 | 77743000 | HPC | * | S4 |
| 36 | 77743001 | HPC | * | S4 |
| 37 | 77743002 | HPC | * | S4 |
| 38 | 77743003 | HPC | * | S4 |
| 39 | 77743004 | HPC | * | S4 |
| 40 | 77743005 | HPC | * | S4 |
| 41 | 77743006 | HPC | * | S4 |
| 42 | 77743007 | HPC | * | S4 |
| 43 | 77743008 | HPC | * | S4 |
| 44 | 77743009 | HPC | * | S4 |
| 50 | 77690502 | TOP MECH ASM | * | S4,5,6 |
| 51 | 77690504 | TOP MECH ASM | * | S4,5,6 |
| 52 | 77690505 | TOP MECH ASM | * | S4,5,6 |
| 53 | 77690506 | TOP MECH ASM | * | S4,5,6 |
| 54 | 77690508 | TOP MECH ASM | * | S4,5,6 |
| 55 | 77690509 | TOP MECH ASM | * | S4,5,6 |
| 56 | 77734091 | TOP MECH ASM | * | S4,5,6 |
| 70 | 77735001 | FRONT PANEL | * | S4 |
| 71 | 77735002 | FRONT PANEL | * | S4 |
| 72 | 77739401 | FRONT PANEL | * | S4 |
| 73 | 77740901 | FRONT PANEL | * | S4 |
| 74 | 77741787 | FRONT PANEL | * | S4 |
| 75 | 77741851 | FRONT PANEL | * | S4 |
| 76 | 77743101 | FRONT PANEL | * | S4 |
| 77 | 77743550 | FRONT PANEL | * | S4 |
| 78 | 77743726 | FRONT PANEL | * | S4 |
| 80 | 77736901 | CAMSHAFT LEVER ASM | * | S4,6 |
| 81 | 77736902 | CAMSHAFT LEVER ASM | * | S4,6 |
| 82 | 77741275 | CAMSHAFT LEVER ASM | * | S4,6 |
| 83 | 77741276 | CAMSHAFT LEVER ASM | * | S4,6 |
| 84 | 77741762 | CAMSHAFT LEVER ASM | * | S4,6 |
| 88 | 77733896 | MEDIA PUSHER | * | S4 |
| 89 | 77734038 | FRAME ASM | * | S4 |
| 90 | 67184761 | SCREW | * | S4 |
| 100 | 77733885 | BASE MACHINING | 50-56 | S5,6 |
| 101 | 77732648 | CLAMP | 50-56 | S5 |
| 102 | 77740821 | CONE GUIDE | 50-56 | S6 |
| 103 | 77740161 | LOAD ARM ASM | 171 | S6,7 |
| 104 | 77734025 | PIVOT SHAFT | 171 | S6 |
| 105 | 77646594 | LOAD ARM SPRING | 171 | S6 |
| 106 | 77732647 | CONE CAM | 50-56 | S6 |
| 107 | 77734019 | BUSHING | 50-56,103 | S6,7 |
| 108 | 94274100 | QUICK-CONN TERMINAL | 50-56 | S6 |
| 109 | 00843511 | RETAINING RING | 50-56,171 | S6 |
| 110 | 77734016 | LEFT GUIDERAIL | 50-56 | S5 |
| 111 | 77740881 | CONE ASM | 171 | S6,7 |
| 112 | 77731286 | LOAD PLATE ASM | 171 | S6,7 |
| 113 | 77741472 | LOAD PLATE SPRING | 171 | S6 |
| 114 | 77740151 | STEPPER MTR ASM | 52 | S5 |
| 115 | 77738817 | BAND ASM | 50-56 | S5 |
| 116 | 77741420 | HEAD ASM | 50,51 | S5 |
| 116 | 77741420 | HEAD ASM | 53-56 | S5 |
| 117 | 77734021 | RIGHT GUIDERAIL | 50-56 | S5 |
| 118 | 10127111 | SCREW | 50-56 | S5 |
| 119 | 10125605 | WASHER | 50-56 | S5 |
| 120 | 92006125 | SET SCREW | 50-56 | S6 |
| 121 | 10127102 | SCREW | 50-56 | S5 |
| 122 | 10125603 | WASHER | 50-56 | S5 |
| 123 | 77671895 | MOTORIZED SPINDLE | 50,51 | S5 |
| 123 | 77671895 | MOTORIZED SPINDLE | 53,56 | S5 |
| 124 | 77734017 | GUIDE ROD | 50-56 | S5 |
| 125 | 77733866 | GUIDE ROD SPRING | 50-56 | S5 |
| 126 | 94277421 | CABLE TIE STRAP | 50-56 | S5 |
| 127 | 77737488 | CONE GUIDE WASHER | 50-56 | S6 |
| 128 | 77732773 | TRACK "O" ASM | 50-56 | S5,7 |
| 129 | 77732646 | INTERPOSER EJECTOR | 50-56 | S6 |
| 130 | 77734026 | EJECTOR SPRING | 50-56 | S6 |
| 131 | 95873210 | SCREW | 50-56 | S5 |
| 132 | 77741931 | DETECTOR HOUSING | 50-56,103 | S6,7 |
| 133 | 56194300 | PLASTIC RIVET | 50-56 | S6 |
| 134 | 10127101 | SCREW | 50-56 | S6 |
| 135 | 10126400 | WASHER | 50-56 | S6 |
| 136 | 10127104 | SCREW | 50-56 | S5 |
| 137 | 77737550 | FLEX CKT HARNESS | 50-56 | S6 |
| 138 | 77612011 | CABLE TIE | 50-56 | S5 |
| 139 | 77732780 | CONE LOAD SPRING | 171 | S6 |
| 140 | 77731291 | SPNDL MTR HARNESS | 50-55 | S5 |
| 141 | 10126220 | SCREW | 50-56 | S5 |
| 142 | 94205369 | SPRING** | 50-56 | S5 |
| 143 | 10125703 | SCREW | 50-56 | S6 |
| 144 | 75738702 | CONN HEADER | 50-55 | S6 |
| 145 | 94277400 | CABLE TIE STRAP | 50-56 | S5 |
| 147 | 77731249 | CABLE GUARD | 50-56 | S5 |
| 149 | 51720201 | RETAINING RING | 50-56 | S6 |
| 150 | 77741421 | HEAD ASM | 52 | S5 |
| 151 | 77671896 | MOTORIZED SPINDLE | 52,54,55 | S5 |
| 152 | 92074152 | O-RING | 50-56 | S5 |
| 153 | 77732791 | CONE LOAD ARM | 103 | S7 |
| 155 | 77734694 | CONE | 111 | S7 |
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| 157 | 77732788 | WASHER | 171 | S7 |
| 159 | 77613703 | BALL BEARING | 111 | S7 |
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| 164 | 94375803 | SCREW | 128 | S7 |
| 165 | 77613529 | CONNECTOR | 128 | S7 |
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| 174 | 77672237 | STEPPER MOTOR | 53-56 | S5 |
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